ANNUAL REPORT

OF THE

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

FOR

1950-51

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SUMMARY

OF THE

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General

Officers Of The Council. The Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, Government of India was *ex-officio* Chairman of the Council upto the 12th May, 1950 and was thereafter succeeded by the Hon'ble Shri K. M. Munshi. Sardar Datar Singh continued as Vice-Chairman and Shri S. R. Maini, I.A.S., as Secretary of the Council. Shri K. R. Damle, Joint Secretary to the Government of India, Ministry of Food and Agriculture, was appointed as *ex-officio* Joint Vice-President of the Council on the 12th Feburary, 1951. Shri T.S. Krishnamurti, Under Secretary to the Council, on his appointment as Secretary, Indian Central Oilseeds Committee on the 29th November, 1950 was succeeded by Shri H. C. Thapar.

Reorganisation Of ICAR Machinery. The entire machinery for research and extension was reviewed by the new Minister when he addressed the Special General Meeting of ICAR on the 1st November, 1950. The objective placed before the Council by him was to help achieve the fulfilment of the Integrated Production Programme under which the land, water and livestock resources of the country will be coordinated on a scientific basis and developed in support of the vast and growing population of the country. The programme offered a challenge not only to the scientific knowledge accumulated by the Council but also to the science of getting the knowledge applied to increasing the productivity of small units. The unwieldy and unplanned expansion of the three type machinery consisting of the ICAR proper, the Central Commodity Committees and the all-India research institutes, made both coordination and direction difficult. These agencies were insulated to a certain extent from the direct impact of the imperative needs of national policy. The funds available for research were divided into a number of earmarked compartments each for a specific purpose. The machinery, though it had served the Council well in the older regime, needed considerable readjustment to enable it to shoulder the extended responsibilities that Independence has brought to it. The Council was invited to play its part in the new agricultural revolution that the country was seeking.

Revision Of Constitution Of ICAR. The constitution of the ICAR was accordingly revised in November 1950 in order to enable it to deal more effectively with its responsibilities. The Governing Body of the Council will now have the assistance of a Board of Research and a Board of Extension in evolving integrated programmes of work in these two major spheres, and it will also be able to delegate part of its work to a Standing Committee, which could meet at regular intervals and enforce the policy laid down. The Council and its various administrative bodies have been reinforced by additional representation for forestry and

fisheries and for specialised organisations such as the Indian Central Commodity Committees, the Central Board of Forestry etc.

Meetings

Meetings of the Scientific and Commodity Committees, Advisory Board, Standing Finance Committee, Governing Body, Standing Committee and Local Sub-Committee of the Standing Committee and the Annual General and Special General Meetings of the Society were held during the year under report.

The first convocation of the Indian Agricultural Research Institute and the first meeting of the Governing Body of the Council, under its new set up, were combined into a joint function held on the 5th Feburary, 1951 and inaugurated by the President of India.

In addition to the Council's current research schemes aggregating 241 (120 on the agricultural side, 87 on the animal husbandry side and 34 under miscellaneous headings), 45 new schemes (28 on the agricultural side, 10 on the animal husbandry side and 7 under miscellaneous headings) were sanctioned during the year at a total cost of Rs. 19.86 lakhs (round). In addition a sum of Rs. 8 lakhs was earmarked for the construction of a building for the Secretariat of the Council. On a request made by the Government of India, in view of the prevailing financial stringency in the country, another sum of Rs. 6.58 lakhs was allotted to meet expenditure on the Secretariat of the Council, for the year 1951-52 which was hitherto charged to the central revenues.

Agricultural Extension Service. The Council has initiated concrete steps for bridging the gap between the results of research and the practices followed by cultivators. The various proposals under consideration in this connection culminated in a resolution passed by the Council for the formation of a National Extension Service. A comprehensive scheme for the establishment of an Extension Service on an all-India basis has been

drawn up in consultations with the various States. Under the scheme, a Board of Extension with the V.P. as Chairman, has been set up at the Centre and corresponding Boards are being set up in the States. Similar Boards or Committees will also be formed lower down at the district and village level. An Agricultural Extension Commissioner has been appointed in the Indian Council of Agricultural Research to coordinate extension work throughout the country.

Land Army. An important plank in the extension work is the Land Army or the "Bhumi Sena" which was formed to utilize the great enthusiasm which exists in the country so as to develop it into a great potential for constructive activity and collective work. The scheme has caught the imagination of the people and the response from every quarter has been very favourable.

It was decided by the Council to reorganise its popular journal the 'Indian farming' with effect from 1st April 1951 so as to make it an effective instrument for disseminating information on agricultural and animal husbandry research and to show to the public more prominently the activities of the Council, research institutes, commodity committees, etc. The reorganised journal has been brought in a manner so as to interest the farmer and his family and to create in him an urge to adopt modern methods of cultivation and animal breeds.

It was further decided that a separate publicity fund should be started to finance the remodelled Indian Farming and that advice of a few leading experts should be obtained as to how best to improve the publicity arrangements under the Council. In order to streamline existing publicity machinery, a foreign agriculture extension publicity expert from the U. S. A. is being invited under the Indo-U. S. Bilateral Aid Agreement.

Rice. Rice still holds pride of place in the Council's researches. In the Kashmir scheme, Chinese varieties have yielded 60 per cent more than other varieties and seed of the same is multiplied and distributed to the cultivators. In Bombay, improved selections yielding 5—25 per cent more than locals are being finalized. Likewise, improved varieties are being evolved in Hyderabad and investigations on economical manuring schedules are being carried out. As regards rice pests, hispa and stem borer, investigations in Bengal indicate that the incidence of stem borer seems to have some connection with lunar motion : possibility of the biological control of this pest is also being investigated. The fungal pests of rice, blast and footrot, are being investigated in Madras, long duration blast resistance varieties (such as Co. 25 and Co. 26) are already evolved, and production of short duration types is now the problem. Footrot, being a seed borne disease is successfully controlled by pre-treatment of seeds by organo-mercuric fungicides like Ceresan and Agrosan G. N. Preliminary investigation on *Helmin thosporium* has been started in Bengal. Interesting information on the manuring of paddy in Bengal and nitrogen fixation in rice soils is also available. As regards the latter, 16 years of researches have shown that considerable amount of atmospheric nitrogen is fixed by the blue green algae (*Anabena*) found in rice fields and it is found that there is greater fixation of nitrogen in denser algal growth which is greater in alkaline soils and in sunlight.

Wheat. As the main problem in wheat is the breeding of rust resistant types, a coordinated wheat rust control scheme is being run at Agra, Pusa, Delhi and Simla. The first part of the work, breeding of rust resistant varieties for the three forms of rust (Black, Brown and Yellow) individually having been completed, the second stage of synthesizing resistance to all the three rusts in one variety by breeding is under way. Promising results

are also achieved in other wheat schemes at Madhya Pradesh and Bombay.

Maize and Millets. The Council has recently taken up investigations on maize, particularly the production of hybrid varieties. Work on improving the technique of production of hybrid maize is carried on at the Indian Agricultural Research Institute, while the actual production of hybrids is proceeded with in the Punjab. As production of hybrid maize from local varieties only, would successfully and constantly give high yields, the first step in the programme of production of local inbreds has been successfully completed ; the next stage of crossing them in suitable combinations for high yields of hybrids is in progress. Similarly the production of hybrid *bajra* has reached an advanced stage in Madras and some of the promising strains (X_1 and X_2) which yielded 29-39 per cent more than the control in different districts have been distributed in suitable regions. In Madras, production of high yielding *jowar* types resistant to the parasitic weed *Striga* is also being undertaken. Promising strains in *ragi* in Bombay and U. P., *sawan* and *kodan* in U. P., *same*, *varagu*, and *godalu* in Mysore are the results of researches carried out on minor or lesser millets. Interesting information on suitable mixed cropping with *ragi* and *sawan* in U. P. and *same* in Mysore are other achievements.

Pulses. Pulses are an important group of food crops in which Council has recently shown considerable interest. Considering the importance of this group of crops in Indian agricultural economy and also the wealth of indigenous varieties available, the Council has been financing a Coordinated Scheme covering almost all soil climatic regions of the Indian Union, for the last ten years. As a result of this, high yielding quality types combining disease resistance also are now available in different pulses, for wider distribution and adoption by the farmers at large.

High yielding varieties of gram are evolved in U. P., Madhya

Bharat, Mysore, Hyderabad, Bombay, Madhya Pradesh and Bihar. Some of the improved grams (BR 17 and BR 65) produced in Bihar have yielded upto 13 maunds per acre. Red gram researches in U. P., Madras, Madhya Bharat, Mysore, Hyderabad, Madhya Pradesh, Bihar and Bombay have produced high yielding quality strains. The Bombay strains have showed not only a high degree of wilt resistance but also about 18 per cent better yield than locals. Likewise, better strains in black gram in Madras, U. P., Madhya Bharat, Assam, Orissa, Madhya Pradesh and Bihar and in green gram in U. P., Madhya Bharat, Assam, Bombay, Orissa, Madhya Bharat and Bihar ; in horse gram at Madras, Mysore, Hyderabad and Orissa ; lentil in U. P., peas in U. P. and Bihar and *khesari* in Madhya Pradesh and Bihar are other useful results. Investigations in Bihar on *khesari* revealed the presence of four leguminous weeds in the trace samples adultering the same up to the extent of about a seventh of the pure *khesari*, some of which may possibly be responsible for the dreaded disease, lathrisum. Improved varieties of soyabeans are also come out of the trials carried out in Mysore, U. P., and the Punjab. In the Punjab scheme, the bold yellow seeded strains called Punjab 1 was found to be not only a high yielder giving upto 2790 lb. per acre but also free from the nutty flavour characterstic of soyabean. This variety has been distributed both inside and outside the state. Interesting information on suitable and economic mixtures of gram with wheat in Madhya Pradesh and black gram with paddy in Orissa have given out useful results.

Spices and condiments. The Council has also a number of schemes on important cash crops belonging to the group of spices and condiments, in various parts of the Union such as cloves in Travancore, cardamom, pepper, chillies, and ginger in Madras, turmeric in Orissa, coriander in Madhya Bharat and *zira* in Rajasthan. Significant aspects of these crops which require investigations to improve their better and larger

production, through breeding high yielding varieties, preventing the ravages of pests and diseases, etc., are some of the important objects of the scheme. And considerable achievements on various counts have been made in all these. For example, it has been found that thrips which seriously limit the production of cardamom could be effectively controlled by spraying with 0.05 percent nicotine sulphate or 0.025 percent Gamexane D dust. Likewise, suitable manuring seems to help in arresting the cardamom disease called "falling off". The causal agent of coriander wilt, the mode of infection etc., are also being found out to breed resistant types.

Pests and predators. Coordinated scheme on tests with D. D. T. and allied insecticides at the I. A. R. I., Bombay, Madhya Pradesh and Madras have given conclusive prophylactic, preventive and control measures for a large number of crop pests such as paddy and *jowar* grass hoppers, paddy and chilly thrips, *cholam* bug, aphids infesting cruciferous vegetables, brinjal, pumpkin and *singhara* beetles, mango hoppers, mealy bugs and storage pests. Interesting information was also available on various virus diseases like Katte disease of cardamom and their transmitting agents.

Fruits. A large number of investigations were also undertaken on various aspects of fruit growing in case of citrus, banana, apple plums, custard apple, grape vine, lichi, papaya and cashewnut, in various parts of the country. Work on root stocks, varietal trials, manurial schedules, disease and pest control and techniques of propagation and cultural operations are some of the important aspects of study.

Animal Husbandry and Dairying

All the research schemes in hand registered a satisfactory progress during the year. With the regionalisation of research, progress was made in the initiation of the two

important schemes : (i) on the setting up of animal nutrition centres for the dry northern region at Anand and (ii) a plan for the improvement of sheep and wool in the best suited regions. To fill in gaps in our milk production, pilot work is in progress to improve the milking capacity of two well known draught breeds, viz. Kangayam and the Hissar cattle without lowering their draughtability.

Livestock breeding. To see how far the provision of better marketing facilities coupled with insurance of cattle life can help in cattle improvement : this is being carried out under a scheme in the PEPSU union. Satisfactory progress has been made and the utility of such work is well demonstrated.

Under the pilot ' Key Village ' scheme in progress in the States of Delhi and U. P. the method of artificial insemination has been introduced with a view to effect economy and obtain quick results from the high quality bulls.

To help meet extra draught capacity required for the increased food production, a scheme for using cows for draught purposes progressed satisfactorily. It has been noted that utilising cows for work did not effect the lactation or reproduction.

Animal nutrition. Satisfactory progress was maintained in the scheme for determining the nutritive value of indigenous grasses and leaves. Besides, these subsidiary feeds are being tried for maintaining livestock from such stuffs as mango seed, kernel, *mahuwa* refuse, and *tarota* seeds. Under another scheme in U. P. it has been found that the nutritive value is more or less equal in the case of barley, maize, *jowar* and *bajra*, but in the feeding of buffaloes, *bajra* and barley were found to be of higher value. Results on the treatment of straw have shown that the alkali treated straw proved beneficial both for growth and milk yield and even the water-washed straw

was found better than untreated straw.

Under dairying, experiments were designed to prevent adulteration and a special delivery can with a tamper proof valve has been now put on trial. Results have also shown that Vitamin 'A' content of buffalo *ghee* decreases on storage at a greater rate than cow *ghee*.

Disease Control. Inspite of the fact that most of the disease investigation schemes previously run by the Council have been taken over by the States, the Council continued to coordinate and scrutinize their technical programmes and annual reports.

A pilot scheme for the control of rinderpest by using lapinised (rabbit-adopted) vaccine in the field has been sanctioned by the Council as a forerunner to the launching of an all-India plan for the control of rinderpest. Efforts were continued for the typing of the types of Foot-and-Mouth virus. Experiments for the evolving of a suitable vaccine were under progress. Investigation of such other diseases as contagious abortion, pleuro-pneumonia, and horn cancer also continued. The incidence of tuberculosis amongst Indian cattle received its due share of investigation and efforts were made to reduce losses from pleuro-pneumonia to help conserve meat animals (goat).

To prevent losses in poultry and thus step up meat and egg production, preventive measures for the control of Ranikhet disease were carried out in all States. Another line of the Council's activities has been to probe into the use of indigenous drugs both in old literature and the knowledge of such, handed down from father to son, in the realm of treatment of animals.

Methods were demonstrated for the control of warble tumors that affect the hide trade.

Agricultural Statistics

The advisory research and teaching activities of the Statistical Branch was continued during the year. The number of persons who received training in agricultural statistics was more than 30.

Sample surveys for the estimation of yields of crops were extended during the year to all principal crops in part A States and some of the part B and C States. A bulletin giving a popular and consolidated account of the surveys so far carried out was published. Similar surveys for assessing the results of the Grow More Food Campaign were also conducted in the various States and it is proposed to extend the scope of these surveys to include an all-India check up of the targets of the construction of irrigational works. In addition to the crop surveys above, a sample survey for estimating the area under principal crop was also initiated during the current year in Orissa.

A pilot enquiry carried out in the U. P. for ascertaining the accuracy of acreage statistics maintained by the *patwari* revealed that although the *patwari* records, in respect of individual fields, are not free from errors, the over-all estimates under the different categories of land utilisation far administrative units like districts and States are broadly correct, at least in respect of the major crops. The investigation has emphasized the need for a rationalisation of the methods af supervision over the *patwari's* work, which now constitutes one of the principal features of the coordinated scheme of crop cutting experiments being implemented under the technical guidance of the Council.

Development

It was found in the Village Rehablitation Scheme, Baroda, that among different systems of land tenure and

farming, the proprietary system yielded the best results and next to it came the leased tenancy system and then the collective system, while the cooperative system, surprisingly stood the last. In the Delhi Development Scheme, directly run by the Council, improved bullock-driven implements, improved seeds of cereals, sugarcane and potatoes, and improved food plants and artificial fertilizers have been introduced and used on cultivators' fields. Crops have been sprayed with insecticides for protection against insect pests, etc. and storage godowns treated for protection against pests.

On the animal husbandry side, improved breeds of poultry and pigs have been introduced and fisheries provided in tanks so as to be a source of income to the villagers. Improvement of livestock has been taken up by castrating scrub bulls by trying to get better bulls through artificial insemination of cows.

Cooperative production and marketing of milk by the villagers has been organised so as to give them better returns. For this purpose, a Milk Supply Scheme has been started and the milk is sold to the public through the sales depots which have been opened in different localities of Delhi and New Delhi.

As a result of the above activities, there has been an increased yield of six maunds of wheat per acre over an area of 6,000 acres and an increased yield of 367 maunds per acre of green fodder over an area of about 4,000 acres. The area under vegetables has increased from 201 acres in 1948 to 491 acres in 1951. Almost the whole of the irrigated wheat area is under improved varieties and improved agricultural implements are now in great demand. Crossbred birds and pigs fetch about 55 percent higher prices without any extra cost to the villagers and have benifited appreciably the Harijans'

in particular. Ponds which were lying useless now give good income to the villagers through fishrearing. The effect of castration of scrub bulls and use of artificial insemination will be visible after some years when the offsprings grow up. Livestock in villages has been protected against epidemics through timely vaccination, etc. The villagers are realising the benefits of cooperative working through cooperative milk production and marketing and through cooperative societies which now handle sale of seeds and implements.

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CHAPTER I—ADMINISTRATION

GENERAL

This is the 21st Annual Report of the Indian Council of Agricultural Research covering the period from the 1st April, 1950 to the 31st March, 1951, presented by its Governing Body, under Rule 64 of the Rules of the Council.

Officers Of The Council

The Hon'ble Shri Jairamdas Daultram, Minister for Food and Agriculture, Government of India was *ex-officio* Chairman of the Council upto the 12th May, 1950 and he was thereafter succeeded by the Hon'ble Shri K. M. Munshi. Sardar Datar Singh continued as Vice-Chairman and Shri S. R. Maini. I. A. S., as Secretary of the Council Shri K. R. Damle, Joint Secretary to the Government of India, Ministry of Food and Agriculture, was appointed as *ex-officio* Joint Vice President of the Council by the Government of India on the 12th February, 1950. Shri T. S. Krisnamurti, Under Secretary of the Council, on his appointment as Secretary, Indian Central Oilseeds Committee, on the 29th November, 1950 was succeeded by Shri H. C. Thapar as Under Secretary to the Council.

The work of research and extension in the sphere of agriculture is shared by three different agencies. Firstly,

there is the Indian Council of Agricultural Research proper which operates by a system of grants for research, initiating and sponsoring the projects all over the country; secondly, there are the Central Commodity Committees with their own research stations and performing similar functions in respect of their respective commodities; thirdly there are the all - India Central Research Institutes which carry on research within their respective fields through their respective divisions. The unwieldy and unplanned expansion of this three type machinery has made both coordination and direction difficult as these agencies are to a certain extent insulated to the direct impact of the national policy. The funds available for research in the country are divided into earmarked compartments, each for a specific purpose.

On his appointment as Minister for Food and Agriculture, and as *ex-officio* Chairman of the Indian Council of Agricultural Research, the Hon'ble Shri K. M. Munshi felt that

(i) With the achievement of independence, the outlook of the Council required reorientation and its approach towards the solution of agriculture problems facing the country which had been colonial in the past should be made national;

(ii) as the very existence of the nation depended on agricultural production, an agricultural revolution in the country should be achieved in a brief span of years and not effected in decades as originally planned;

(iii) the Indian Council of Agricultural Research in order to justify its existence to the nation would not merely content itself with the mere coordination of effort in the field of research by the various State Governments, etc.;

(iv) the object of the Council should be to help achieve the fulfilment of the Intensive Cultivation Programme of the Government of India under which the land, water and livestock resources of the country were to be co-ordinated on a scientific basis and developed in order to support its vast and growing population;

(v) the activities of the Council should extend to the field of agriculture, animal husbandry, forestry and fisheries and allied subjects in all the three different stages; viz.

(a) fundamental research,

(b) technological investigation, and

(c) introduction into practice,

with the ultimate object of land transformation, i. e. to secure the utilisation of land on a rational basis for the development of land, water and livestock resources to their maximum potential and assuring a decent standard of living to the population;

(vi) improvements on scientific lines, though available, had not been fitted into the agricultural system and social organisation of the country;

(vii) while the important projects of research be assured of adequate funds throughout their duration, compartmentalism should not hinder substantial financial allocations being made when required by important changes in the national policy;

(viii) the available funds and technical personnel in the country should be utilised to the maximum advantage and the optimum drive imparted to the agricultural research activities themselves;

In order to achieve the objects mentioned in the foregoing paragraph, the Hon'ble Minister, therefore, decided that :

(i) The machinery of the Council which had served it well in the older regime should be readjusted to enable it to shoulder the extended responsibilities.

(ii) The administrative set up of the Council should be so altered that a coordinated programme of research could be envolved in each sphere in the fields of agriculture, animal husbandry, forestry, fisheries and allied subjects for the whole country and its execution secured by different research institutions, either controlled directly or indirectly by the Centre, a State Government, a University or a private body.

(iii) The Council through its constituent bodies, should assist by technical advice and financial grants at the same time maintaining appropriate standard and effective speed.

(iv) The revised machinery should enable complete decentralisation in the conduct and responsibility of particular approved projects.

(v) In order that the Council might function effectively, its Governing body, which on account of the number of States in the Union had become very bulky should have a Standing Committee to afford relief to that Body in the discharge of its executive functions with a Board of Reseach and a Board of Extension to advise it in their respective spheres.

Necessary amendments to the rules of the Council were accordingly made by the Society at its Special General

Meeting held on the 1st November, 1950. Under the revised rules, the Council now consists of :

(i) the Governing Body;
(ii) the Standing Committee;
(iii) the Advisory Board;
(iv) the Board of Research; and
(v) the Board of Extension.

In addition, the Council has a Standing finance Committee, constituted under the Agricultural Produce Cess Act, 1940, to advise it in financial matters.

The designations of the Chairman and the Vice-Chairman of the Council were changed to the President and the Vice President, respectively.

Under the amended rules, fresh or additional representation has been given on the Society to :

(i) the Government of India in the Ministry of Food and Agriculture.
(ii) Part 'B' and 'C' States.
(iii) the Parliament of India.
(iv) the Central Rice Research Institute.
(v) the Central Potato Research Institute.
(vi) the Institute of Agriculture, Anand.
(vii) the Central Gowshala Development Board.
(viii) the Vana Premi Sangh.
(ix) the Forestry Board.
(x) the Council of Scientific and Industrial Research.
(xi) All India Women' Food Council.
(xii) the Malwa Board.
(xiii) the Southern India Board.
(xiv) the Malnad Development Committee.

(xv) the Indian Coffee Board.

(xvi) the Indian Rubber Board.

(xvii) Central Commodity Committees, viz.

(a) the Indian Central Cotton Committee.

(b) the Indian Central Jute Committee.

(c) the Indian Lac Cess Committee.

(d) the Indian Central Sugarcane Committee.

(e) the Indian Central Coconut Committee.

(f) the Indian Central Tobacco Committee.

(g) the Indian Central Oilseeds Committee.

(h) the Indian Central Arecanut Committee.

(xviii) the Fisheries Research Stations, and

(xix) rural interests in the country.

Meetings

During the year under report, the following meetings of the Council were held :

(i) Special General Meeting, November, 1950.

(ii) Scientific and Commodity Committees November, 1950.

(iii) Advisory Board, from the 3rd to the 5th January, 1951.

(iv) Annual General Meeting 5th January, 1951.

(v) Joint Meeting of the Board of Agricultural Research under the Ministry of Agriculture and the Board of Extension of the Council, 6th January, 1951.

(vi) Standing Finance Committee, July and September, 1950 and January, 1951

(vii) Governing Body, February, 1951.

(viii) Standing Committee, February, 1951.

(ix) 1st, 2nd and 3rd meeting of the Local Sub-Committee of the Standing Committee of the Council on the 2nd, 7th and 26th March, 1951 respectively.

The first meeting of the Governing Body of the Council under its new set-up and the first Convocation of the Indian Agricultural Research Institute were combined in a joint function which was held on the 5th February, 1951 and inaugurated by the President of the Indian Union.

Allotment of Funds

In addition to the Council's current schemes aggregating 241 (120 on the agricultural side, 87 on the animal husbandry side and 34 under miscellaneous headings), 45 new schemes were sanctioned during the year at a total cost of Rs. 19.86 lakhs (round) to the Council as follows :—

Agricultural Schemes ...	28
Animal Husbandry Schemes ...	10
Other Schemes ...	7

Funds to the extent of Rs. 14.77 lakhs were also provided for the extension of 37 current schemes, that were either due to expire during the year or for which allotment of additional funds was found necessary. In addition, a sum of Rs. 8 lakhs was earmarked for the construction of a building for the Secretariat of the Council. On a request made by the Government of India, in view of the prevailing financial stringency in the country, another sum of Rs. 6.58 lakhs was allowed to meet the expenditure on Secretariat of the Council for the year 1951-52, which was hitherto charged to the central revenues.

Agricultural Extension Service

To facilitate the application of the results established

by agricultural research to the conditions under which the great mass of farmers practise agriculture, to strengthen and realign the existing state machinery by associating enterprising farmers and non-officials and public institutions and thereby bridging the gap between the agricultural research and the actual agricultural practices, a scheme for the establishment of an Extension Service on an all India basis has been drawn up by the Indian Council of Agricultural Research in consultation with the various State Governments. Under the scheme, a full-time Director of Extension, in charge of the extension activities has been appointed at the Centre. His duty is to advise the State Governments in regard to the scheme as also to foster the development of extension activities throughout the country and to coordinate them. A Board of Extension with the Vice-President, I. C. A. R. as its chairman has also been set up at the Centre. A similar Board of Extension will be set up in each State with the Minister of Agriculture of the State concerned as Chairman and its Director of Agriculture as its Vice-Chairman. Representatives of agriculturists will also be on these boards. Lower down, District Boards of Extension will be established to take charge of the work within their areas.

It is felt that no attempt for a successful Extension service can be made without the cooperation of the enterprising farmer who is the pivot of prompt and effective agricultural reform. It has, therefore, been decided to set up an organisation by the name of 'Bhoomi Sena' (Land Army) for enlisting enthusiastic young-men from the villages and the village leaders, as well as others interested in agriculture. 'Bhoomi Sena' will be organised at the inception of the official agencies but ultimately it will work though non-official agencies. Such agencies

will maintain continuous contact with the extension agencies, follow up the advice given and assist in rural development work generally. The programme of work to be carried out by the Land Army will include such simple items of work as -

(a) Planting trees and their maintenance (single trees and groves) ;
(b) composting (including the use of municipal waste and sewage where possible) ;
(c) growing vegetables;
(d) simple methods of pest and disease control;
(e) protection from wild animals;
(f) eradication of weeds;
(g) consolidation of holdings where possible;
(h) tank improvement, maind-bundies, digging of drainage channels etc,
(i) fish culture;
(j) crop competition scheme and
(k) immunizing of cattle;

Publications And Publicity

Indian Farming : The number of subscribers for 'Indian Farming,' during the period under review remained unchanged. A special number of 'Indian Farming' was published on the occasion of the Diamond Jubilee of the Indian Veterinary Research Institute, Izatnagar in place of the March (1951), issue of the journal. These celebrations coincided with the biennial meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India at Izatnagar.

In March, 1951, 8 issues of the 'Indian Farming' were in arrears. In order to liquidate these arrears, issues for November and December 1950 and January and February 1951 were combined.

The Local Sub-Committee of the Standing Committee of the ICAR, at its meeting held in March, 1951, decided to reorganize the 'Indian Farming' with effect from 1-4-1951 so as to make it an effective instrument for the dissemination of information on agricultural and animal husbandry research in the country, as also for the popularisation of the activities of the Council, various research institutes, Central Commodity Committees and other allied organisations and also to give fillip to the G. M. F. drive. The reorganized journal is to be brought out in a manner so as to interest the farmer and his family and to create in him an urge to adopt modern methods of cultivation for better crop production and animal breeds. The printing, publication and distribution of 'Indian Farming' was, as a trial, entrusted to a private agency, viz. the Associated Printers and Advertisers Ltd., Bombay who were to print the first three pilot issues on a no-profit basis. This was done in order to avoid delays, which the Government press could not help and with a view to improve the get up of the journal.

Kheti : The publication of Kheti (Hindi journal) fell into arrears due to unsatisfactory printing arrangements. The Controller of Printing and Stationery India, has been requested to make arrangements with a press which will ensure proper and timely service and also help to liquidate the arrears.

Scientific Journals: The printing position of the Council's scientific journals, viz. the 'Indian Journal of Agricultural Science' and the 'Indian Journal of Veterinary Science and animal Husbandry', remained unchanged and in March, 1951 as many as 5 issues each of the journal were in arrears. It is, however, expected that out of these, 3 issues of each of two journals will be released shortly.

Monographs and bulletins : The following Bulletins were

published during the period under review :-

1. Bulletin No. 24 entitled "A Brief Survey of some of the Important Breeds of Cattle in India", Part II (Second Edition) Reprinted.

2. Bulletin No. 45 entitled "Investigation on the Cold Storage of Potatoes" by D. V. Karmarkar and B. M. Joshi (Second Edition) Reprinted.

3. Bulletin No. 47 entitled "Definition of characteristics of Kangayam, Khillari and Tharparkar cattle and Nilli and Surti Buffalloes" (Second revised Edition) Reprinted.

4. Bulletin No. 49 entitled "Investigation on the Cold Storage of Nagpur Oranges" by D. V. Karmarkar and M. B. Joshi (Second Edition) Reprinted.

5. Bulletin No. 60 entitled "Preparation of Compost Manure from Town Wastes" by C. N. Acharya (Fourth Revised Edition) Reprinted.

6. Bulletin No. 62 entitled "Indian Potato Varieties" by B. P. Pal and Pushkarnath.

7. Bulletin No. 68 entitled "Review of Green Manuring Practices in India" by B. K. Mukerji and R. R. Aggarwal.

8. Bulletin No. 69 entitled "Estate Farming in India".

Publicity

In order to bring about improvement in the existing publicity machinery, it has been decided to invite a foreign publicity expert from the U. S. A. under the Indo-U.S. Bilateral Aid Agreement. He is expected to streamline the publicity machinery of the Council and introduce the dynamic publicity concepts and principles used in foreign countries.

Publications Committee

The Committee made the following recommendations :

(i) That the Adarsh Seva Sangh which is responsible for printing the 'Rural India' be granted a subsidy, provided it fulfils the usual conditions laid down for the grant of such subsidies.

(ii) That the Scientific Monograph No. 6 entitled 'Helminth Parasites of the Domesticated Animals in India' by Dr. G. D. Bhalerao, be revised and that the work relating to its revision should be entrusted to Dr. S. Datta and a Research Officer (Helminthology, in I. V. R. I.).

The Advisory Board at its meeting held in January, 1951, accepted these recommendations.

The Committee also decided (i) to accept the monograph on 'Veterinary Entomology and Acarology for India' by S. K. Sen and T. Bainbridge Fletcher for publication.

(ii) To consider abstracts of articles from foreign journals for publication in the I. J. V. S. received from persons other than those working at the I. V. R. I. and I. D. R. I.

(iii) That the proposal for the regular publication of comprehensive reviews on different subjects connected with agriculture and animal husbandry should be examined by the Secretariat of the Council. The proposal is at present under active consideration.

CHAPTER II—AGRICULTURE

Rice

Rice being the most important food crop, the Council devotes considerable attention to its improvement. Eleven schemes were in operation at different centres during the year of which seven were on breeding and agronomy, three on pests and diseases and one on manurial requirements. The salient points from the results, as reported for the year, are given below :

Breeding and agronomy

In the Kashmir scheme, the Chinese varieties which have been fully acclimatised by now, continued to give higher yield (an average of 60 per cent and more than other imported and indigenous kinds). As a result of these trials, the cultivators are well impressed with the higher productivity of the Chinese varieties and have voluntarily taken up their cultivation. The Department of Agriculture multiplied a considerable quantity of the seed for distribution to the cultivators. In view of the good performance of the Chinese varieties the question of spreading them to other comparable areas has been taken up. The Russian Dry Land Paddy was cultivated on trial basis by the Department with success for the first time in Gurez sub-valley.

The Bombay Scheme which was to terminate in March, 1950 has been given an extension for two years after which it is to be taken over by the State Government.

Promising selections, significantly superior to local by 5 to 25 per cent (Sukhwel, Sutarsal, Juasal and Pankhali for Kaira District and White Kada, Red Kada, Waukvel and Early Kolam for Surat district) have been isolated. After conducting district trials the best will be released for general

cultivation in Karia and Surat districts. In the spacing cumseedlings per bunch experiments, the two years results are in favour of the lowest spacing of 6 x 6 the results regarding the number of seedlings per bunch are not consistent.

In the preliminary yield tests in Hyderabad Rice Scheme, Eshwarkora a coarse, red grained variety of Madras, gave the highest yield and H. S. 35, which was used as the standard, recorded the lowest yield. This and other cultures, found to be significantly superior to H S 35, are being retained for further trails.

Experiments with organic manure on HS 35 were not significant. But considering results of the last four seasons it is found that groundnut cake gives the best results giving a profit of Rs. 46 per acre followed by castor cake. The compost gave the least response.

Only preliminary work was done in the schemes in Coorg, Punjab and West Bengal.

The two schemes on deep water paddy sanctioned in Uttar Pradesh and Orissa and the scheme for the improvement ef hill paddy in Orissa were not put into operation during the year due to the financial stringency of the State Governments.

Pests and diseases

The two major pests of paddy - rice hispa and rice stem borer—which are widely distributed and cause an appreciable damage to paddy crop in west Bengal are under investigation with a view to devise control measures. It was noted that during the full moon week the activity of the stem borer appreciably decreases as compared to no moon week. In regard to rice hispa it was noted that the intensity of attack in the transplanted stage was significantly high as compared to the intensity of attack.

The possibility of controlling the stem borer by breeding an indigenous parasite in the laboratory in large numbers and releasing the same in the field to coincide with the first egg laying by the moths is being considered in the Central Rice Research Institute, Cuttack.

All the three important diseases of rice - blast, Foot rot and Helminthosporium - are under investigation in two schemes financed by the Council, the former two in Madras and the last one in West Bengal. The high yielding Blast resistant strains Co.25 and Co.26 have already been released which are becoming popular among cultivators of Tanjore Delta in Madras. Both these strains are, however, of long duration, suitable only for tracts where water supply is available for six months at least and the climatic conditions favour the growing of long duration strains. The need for short duration cultures is great and attention is, therefore, being concentrated on such material. A number of short duration hybrids are being tested and a few promising cultures have been picked out. These will be further tested and suitable final selection will be made. In addition to field studies work was done to determine the factors responsible for resistance of varieties to the disease and it was found that resistance was co-related to the number of silicated epidermal cells in unit area of the leaf surface. This finding is in conformity with the results obtained by workers elsewhere. The investigation brought to light the presence of a number of grasses, which grow in paddy lands and act as alternate hosts of the fungus. Of these *Panicum repens* is widely distributed throughout the State and would appear to be the most important of the grasses in harbouring the disease in the off season and acting as a reservoir of inoculum for the initial spread of the disease to the rice plant.

Foot rot has been successfully controlled by treating the seed with organo mercury compounds like Agrosan or Ceresan G N at the rate of one gram for one pound of the seed. Large scale demonstrations are being carried out in the districts of Godavri, Kistna Coimbatore and Madura to popularise the method of control among the cultivators.

Studies on the Helminthosporium disease started late in February, 1950 in West Bengal. The pathogen *Helminthosporium oryzae* was isolated from a number of samples. The fungus was cultured on various media to find out a suitable medium for sporulation of the fungus. Encouraging results were obtained with one particular medium on which the pathogen sporulates and this ensures proper specific identification of the fungus. For soil inoculation studies in the coming paddy season inoculum was prepared. Stubbles of paddy were collected from different places for examination and isolation to test the presence of the fungus. Soil samples were collected and isolation of the soil borne fungi was started.

In the scheme for manurial experiments (to find out the effect of continuous application of ammonium sulphate on the same paddy lands) the overall responses due to ammonium sulphate were not very pronounced at the Chinsura Farm. The extra grain and straw yields obtained by the application of bonemeal and farmyard manure were very small at this farm being almost negligible. By the application of lime, no increase was obtained at all. Similar results were obtained last year also. At the Suri and Chinsura farms, however, the application of ammonium sulphate had given remarkable results, the grain and straw yields increasing with the increased doses of ammonium sulphate as in the previous years. The effects of bonemeal and farmyard manure were not so pronounced at the Suri farm as of

ammonium sulphate but they also tended to increase the yield of grain and straw, while at Berhampur farm they were found to have no effect on the yield. Lime was, however, found to have no effect on the yield at both the farms.

Nitrogen fixation in rice soils

The final report of the investigations on nitrogen fixation of the rice plant, carried in Dacca, reveals some interesting results. The object of the scheme was to determine the part played by soil bacteria, algæ and rice plant roots in fixation of atmospheric nitrogen under water logged conditions. The results obtained have shown that :

(i) Algal growth is greater in alkaline soil.

(ii) Nitrogen fixation is greater,

(a) in sun-light than in dark

(b) in denser algal growth.

(iii) All forms of algæ are not capable of nitrogen fixation but only the three forms of the blue green algæ, *Anabæna,*

(iv) Nitrogen fixation by algæ is stimulated by carbon dioxide liberated from rice roots, which by dissolving mineral in the soil make them available to algæ.

(v) Algal growth is deterimental to the development of 'Azatobacter' which did not play any part in nitrogen fixation in rice soils and,

(vi) The rice plant cannot by itself fix in nitrogen.

The remarkable discovery from this investigation has been that there is a symbiotic relationship between the rice plant and the blue grown aglæ by which the

former supplies carbon dioxide to make available the nutrients beneficial to algal growth, while the algæ by fixing atmospheric nitrogen enriches the soil to the advantage of the rice plant. As all these investigations were carried under laboratory conditions the Government of West Bengal and the Director, Central Rice Research Institute are undertaking field trials to confirm these findings.

Two new schemes on rice breeding were sanctioned during the year to start from 1-4-51. The first is at the Central Rice Research Institute, Cuttack for hybridisation between 'Japonica' and 'Indica' rices for stepping up yields. The 'Japonica' varieties are high yielding, give a higher percentage of rice to paddy, have short and non-lodging straw and can withstand intensive manuring while the 'Indica' group germinates quicker, has better tillering capacity and is resistant to drought and diseases. An intensive programme of crossing between the two races and selection from the hybrid progenies should, it is expected, provide the material that should prove useful to India. The other scheme is for the improvement of paddy for cultivation in the hills (4000 ft. and ahove) in the temperate areas of Assam.

Wheat

The co-ordinated wheat rust control scheme sanctioned by the Council is being run at the under-mentioned stations :

Botanical : Delhi, Pusa and Simla.

Mycological : Agra, Delhi and Simla.

The working of two portions is briefly described below :

Botanical : The previous investigations carried on under the scheme for breeding rust resistant varieties of

wheat for the hills are being continued and intensified. The previous work was initiated in two stages, the first being the breeding of resistant varieties for the three rusts—black, brown and yellow—individually and the second stage being to synthesise resistance to all the three rusts in one variety by breeding. The first stage of the work has been completed and during the last three years a set of varieties resistant to different races of individual rusts were sent out for trial both in the hills and the plains. A few of these have shown good promise and have been selected for further trials.

The work on the second phase is in progress. In a few crosses, in advanced generations, rust resistant and agronomically desirable strains have been selected and such of these progenies as are breeding pure have been put under test trials. The progenies of a number of other crosses are under initial stages of selection.

As yellow and black rust of barley too attack the wheats, preliminary work on breeding for rust resistance in barley is also in progress. Search for resistant barley varieties and the utilisation of the same in breeding is in progress.

Mycological : The Agra Centre which was being run under Dr. K. C. Mehta was shifted to Delhi on account of his untimely death.

Wheat Research Scheme, Madhya Pradesh

The object of this Scheme is to breed rust resistant wheat strains suited to the black soil areas of the State. It has been sanctioned upto the 31st March 1953.

Two new strains, one supplied by Dr B. P. Pal,

I. A. R. I., and another Dowerin supplied by the Plant Pathologist, Mahableshwar were found, on testing at Mahableshwar, to be resistant to black rust.

As observed in the preceding year, the early maturing Canadian 'durum' strain showed good growth. Its ear is compact and long containing red and plump grain. On testing again at Mahableshwar it was found to be resistant. Since a resistant 'durum' strain is now available for crossing with the local 'durum' varieties, fresh inter specific crosses will not be attempted.

A number of progenies and bulks of different series of wheat were grown at Powerkheda and studied in detail. The row trials of 116 'vulgare' and 116 of 'durum' progenies selected from the collection of local wheats were repeated during the year. Besides, forty 'vulgare' progenies were compared for yield under high level of fertility, i. e. manuring and irrigation.

The selected F 6 and F 7 families breeding true for resistance were grown and tested in two or three separate plots. Further confirmation of their being homozygous for the character of rust resistance was obtained. Although infection varied from plot to plot judging by the maximum infection observed on them, they were classed as resistant. They have been breeding true for resistance for three or four generations and hence multiplication of their seed at Powarkheda has already been undertaken.

Wheat Rust Research Scheme for Peninsular India (Bombay)

The object of the scheme is to test the reaction of wheat against black stem rust in the seedling stage and to carry out tests for adult resistance in the field and is sanctioned upto the 31st March, 1952, for the present.

Thirty-nine new wheat variaties were tested during

the year. Strain 88 obtained from the I. A. R. I. was found to be highly resistant to all the ten races occurring in India. Other strains were either highly or moderately resistant to these races. C-217, a wheat variety reported to be resistant to stem rust in the Punjab was found highly susceptible in the seedling and adult stages at Mahableshwar. Gaza remained highly resistant to all the ten races as in the previous year. Its resistance is not affected by a rise in air temperature.

Selections from the following crosses sent from Madhya Pradesh for testing, have behaved as resistant to stem rust consistently for a period of two to four years and are, therefore, recommended for multiplication if they are suitable in other respects :

(i) N. P. 52 x C. 9906
(ii) 291. J. 1. 1, 1. x A. O. 90
(iii) C. 9960 x A. O. 90
(iv) (Bobin x (Bobin x Gaza) x A. 115)
(v) A. O. 13 x E. 220
(vi) A. O. 90 x E. 220
(vii) A. O. 98 x E. 220
(viii) E. 220 x N. P. 52
(ix) A. 115 x E. 220
(x) E. 220 x N. P. 100

Wheat Breeding Scheme for Rajasthan

A scheme for wheat breeding has been sanctioned for Rajasthan for a period of 5 years from the 1st April, 1951. The object of the scheme is to select suitable type or types of wheat for various soil and ecological conditions of different parts of Rajasthan as the previous trials were restricted to the Jaipur Division only. Only breeding work is to be done under the scheme while testing for rust resistance will be done at one of the Mycological centres of the Co-ordinated Wheat Rust Control Scheme.

Barley

A scheme for barley breeding in Rajasthan has been sanctioned by the Council for four years. The object of the scheme is to carry on breeding work on barley in the state as Rajasthan contains material with sufficient variability to respond to selection. It is stated that the improved barley type introduced from Uttar Pradesh, Punjab and I. A. R. I. tried against the local barleys in Rajasthan did not prove superior.

Maize

Maize is an important crop occupying more than 7 million acres. The Council is financing schemes at different centres for the improvement of this crop by adopting the hybrid vigour technique. The results are summarised below :

I. A. R. I. One hundred and one open pollinated varieties that had been collected from the different States were grown in observation plots. The varieties showed a good degree of variability in the different characters studied, in plant height, number of good cobs per plant, ear length, number of kernel rows. Twenty nine Indian and nine foreign varieties together with twelve double crosses were tested in replicated yield trials. Among the Indian varieties, Pusa types P4, P5, P 14, Punjab 22, Rampur Swar White, Rampur (St.) White 11 A, Meerut yellow, Kanpur T. 31, Rampur State Poria, Chit Bhaiya Bini, Aurangabad 7 and Jaunpur White too ranked as high-yielders. In maturity, the Birbum Bhutta types 27 and 28 and Tidki were the earliest and the Darjeeling varieties the latest.

Among the foreign varieties, Beladi, Hot Not, Knoxville and Leaming ranked as high yielders. The foreign varieties were all late, American Early Dent, Leaning Fitzroy and

Beladi being the latest in silk.

Twenty four double crosses received from the U. S. A. were tested in replicated yield trials at four centres, namely, New Delhi, Kanpur, Coimbatore and Nagpur. In general, the hybrids from the States of Iowa, Indiana and Ohio and U. S. 13 did well at New Delhi and Coimbatore. Wisconsin 1600 was the earliest, the difference in silking between this and the local being 22 days. At Nagpur, Kanpur the yields of all the hybrids were very poor, owing to very late sowings.

Fifty-nine pairs of selfed vs. sibbed lines were in the S1 and Sb1 generation respectively. Twenty-nine of them were carried to the succeeding generation of selfing and sibbing. On an average of fifty seven pairs, the sibbed lines were significantly better than the selfed lines in respect of plant-height, ear-height, stalk girth number of nodes, total number of cobs and number of good cobs per plant and eargirth.

A number of lines were carried to the S3 and S4 generations. They were also topcrossed to Pusa Yellow 2 with a view to studying the performance of their progenies in comparative trials.

The pollen of jowar, bajra and several grasses was deposited on maize silks but no seed formation took place.

Over four hundred inbreds were selected for further inbreeding. Some of the desirable liking lines were topcrossed in order to study their general combining ability.

A number of plants were selfed in some Indian and foreign varieties and in a few double crosses with the object of isolating superior lines from them.

Uttar Pradesh. Thirty-two varieties were subjected to inbreeding, and only about one hundred and eighty

selfed ears were available for the next year. The amount of seed setting varied very considerably from ear to ear, some of the ears having hardly a dozen seeds while some were of normal size and setting.

An imported double hybrid C. of Messrs Funk & Co., (U. S. A.) was compared for yield against four selections of maize from different parts of U. P. and a local unselected variety of locality, at Kalianpur, Bahraich and Benaras. At Kalianpur the hybrid and type 41 (the heaviest yielding selection) yielded equally, while the other varieties yielded less. At Bahraich the highest yield was secured by type 41. The trial at Benaras failed due to excessive rains.

A preliminary trial of hybrids imported from U. S. A. and some top-crosses made by Shri Boshi Sen was conducted with type 41 and Kalianpur local as controls. The late top-crosses yielded higher than the early ones, but not higher than type 41.

A separate experiment was laid down to study the effect of spacing and nitrogen level on yield, cob size and number of cobs per plant. Type 41 (medium-late) type 4111 (early) and hybrid G. (medium-late) were used for this experiment, in a complex factorial design at three levels of nitrogen (40 lb, 80 lb, and 120 lb N. per acre) and at four different spacing 2ft.×1ft, 2ft.×2ft, 3ft.×1ft and 3ft×2ft.

Type 41 yielded higher than hybrid G. The response to nitrogen was very marked. The highest-yields were given by 2ft.×1ft. and 2ft.×2ft. spacing followed by 3ft.×1ft. The owest yield was given by 3ft.×2ft. spacing.

Punjab. As grain or cob samples of about three hundred commercial varieties from all the important maize growing regions of the Punjab as well as other States of the Union

had been collected in the past four years, further collection work was discontinued.

Inbreeding work continued to remain as the major item of programme of work. In all, about 4,000 plants, were artificially selfpollinated during the year, of which 3,674 plants had set grains.

Detailed observations were recorded on 712 of the 1,393 inbred progenies (255 S1, 110 S2, 282 S3 & 65 S4) raised at Jullundur in respect of all the improtant agronomic characters. Inbreeding had, on the whole, a depressing effect on the vigour of the resultant progenies, the adverse effect being most pronounced in the S1 generation (when the commercial varieties are subjected to first selfing and less so in subsequent generations). The characters observed to be most adversely affected were cob length, 100-grain weight and grain yield per plant. It was also noted that although the general trend of the inbred lines was towards decline in vigour, a few of them maintained substantial vigour even after three or four successive selfings. In spite of very heavy borer attack during Kharif 1949 at Jullundur, eight out of a total of 1,3,93 inbred lines under observation were free from borer attack whereas none of the commercial varieties escaped this attack.

As regards the effect of selfing on purity, the data compiled on coefficients of variability in respect of major agronomic characters revealed that most of the inbred lines tended to attain uniformity rather gradually, particularly so for such characters as yield, cob-length, 100 grain weight and height. Some of the inbred lines, however, appeared to have attained reasonable uniformity in respect of all these characters after only 3 or 4 generations of selfing. In this connection particular mention may be made of 6 S3 and 4 S4 lines, in which case the

values for C. V. were for all the major characters under observation.

The 31 'top' crosses attempted during Kharif 1948 were put under replicated progeny row tests at Jullundur, Nagrota and Kulu during kharif 1949 and of these as many as 14 gave higher yields than even the heaviest yielding of the local commercial varieties kept as standards in these tests. The inbred lines used as one of the parents in the 'top' crosses, which gave higher yield than even the best 'local' possess, high combining ability and as such they can be of great value in making fruitful 'single' and 'double' crosses.

Apart from testing of the crosses attempted during Kharif 1948, 87 new 'top' crosses were also attempted during kharif 1949, between 77 S4 and 5 S3 lines.

Single crosses were also attempted during kharif 1948 with a view to save time and achieve quick economic results. The 89 'single' single crosses, so attempted, were put under replicated progeny row tests at Jullundur, Nagrota and Kulu. As many as 24 out of 83 crosses under test at Jullundur outyielded even the highest yielding of the 'locals' as standards. Three of these crosses, viz., S. C. 27. S. C. 38 and S. C. 17A, out-yielded the best 'local' by significant margins, their excess over the latter being 56.34, 49.62 and 26.35 per cent respectively. The yield data for the 'single' crosses was also collated with that for top crosses and a marked correspondence between the two was observed, the high yielding 'single' crosses generally being those which had one or both of the parental inbred lines possessing high combining ability, as revealed by their performance in 'top' crosses. It is thus apparent that 'top' crosses serve a very useful purpose in locating good inbred lines which could be utilised in synthesizing high yielding 'single'and 'double' crosses.

As the use of 'double' crosses has been found to be more remunerative than 'single' crosses in raising commercial crops, it was considered worthwhile to attempt 'double' crosses between such 'single' crosses as appeared promising-looking and vigorous in growth. In all 37 double crosses were made during kharif 1949 between 10 single crosses.

Ready-made hybrids from abroad were imported to test their suitability under Indian conditions. 50 ready-made crosses imported last year from U. S. A. Canada, and Australia were put under replicated progeny row test during kharif 1949. Some of them did very well at Kulu giving 3.34 to 34.29 more yield than even the best of the three 'locals' kept as standards there. Two of these crosses, viz., Iowa 4417 and U. S. 13, gave significantly higher yield than the best 'local'.

Experiments to determine the best ratio between pollenparents and pistillate-parent rows for the production of hybrid seed showed that 1:2 ratio (one row of pollenparent to two rows of pistillate parent) is the best for efficient production of hybrid seed with inbred ones as parents, the average number of grains set per cob on pistillate parent (detasseled) rows being the highest (350.5) in this ratio, and the average number of unfertilized ovules per cob being the least (9.5).

The possibility of raising two crops of maize in a single year to reduce the period required for synthesizing high yielding cross-combinations was successfully experimented by sowing an early crop at Nagrota towards the end of March, 1950. The crop was a considerable success and the breeding material developed in this crop matured in time to be available before the normal sowing time of maize crop in the plains, which is about the second

week of July. This arrangement will greatly accelerate maize breeding work as it would enable to attempt 'single' and 'double' crosses between inbred lines possessing high combining ability in the same year when their performance in 'top' crosses is known instead of writing for the next kharif season.

New schemes. A new scheme on maize has been sanctioned in Hyderabad State to start from 1st April, 1951 as there is no maize improvement scheme to cater to the special requirements of Peninsular India.

Two small centres—one in Rajasthan and the other in PEPSU have also been sanctioned this year for work on maize to work in collaboration with the main centres in Punjab and I. A. R. I. respectively.

Millets

Jowar (*Madras*) Jowar which is second important crop in Madras State is subjected to the attack of a root parasite striga which causes considerable damage to the crop. Investigations on this problem are in progress in Madras since last year. The object is to built up homozygous strains of *jowar* resistant to striga attack, and to find out suitable agronomic methods to control this weed pest.

A survey of the incidence of the striga attack on sorghum was made in some of the areas of all the four (Coimbatore, Nandyal, Hagari and Lam.) centres of work. The occurrence of striga is rare in year of high rainfall and in soils of rich fertility. Collection of striga seeds was also made. Derivatives of the crosses between Bonganhilo selection A. S. 4003, with strains of Co. 1 and N. I. and T. 6 of different stages of generation were sown at Coimbatore to test their strain resistance. At Nandyal 10 derivatives of crosses of N. I. and T 6 with A. S. 4003 in F5 and F6 generations sent from Coimbatore were sown for further tests.

Bajra (*Madras*). Investigations on bajra are in progress in Madras for production of hybrids that can give higher yields than the local varieties.

A few hybrids have already been evolved which are undergoing district trials. The results are summarised below :

The two hybrids strains X. 1 and X. 2 gave 18 per cent more grain than the local at Dindigul (Mathura), 30 and 39 per cent respectively at Namakhal (Salem) and 35 and 36 per cent at Sathur (Ramnad), X. 1 gave 29 per cent more grain than the local at Koilpatty (Tinnevelly). However, they were not suitable for Bellary, Chittoor and Vizagapatnam districts. 715 lb. of X. 1 and 710 lb. of X.2 were issued from the Millet Breeding Station, Coimbatore for raising seed farms in Coimbatore and other districts. The seeds produced in these seed farms will be purchased back for large scale distribution to cultivators.

Experiments to determine the extent of natural crossing that can be obtained under different methods of sowings showed that maximum crossing took place when the seeds were in the proportion of 1 : 2 followed by a mixture of 1 : 1 of female and male parents. As to spacing, the maximum crossing occured when the rows were spaced two links apart. This is, however, not in conformity with previous years results. In the comparative trials with short duration (75 to 80 days) hybrids, 5 of the nine hybrids tested were found to be significantly superior to their parents and the standard (Co 3). In the comparative trials of hybrid, seeds of the hybrid X. 2 produced by 6 different methods were tested. It was found that hybrids seeds produced by (1) sowing the parent seeds mixed in equal proportions and harvesting the whole plot in a bulk and (2) sowing either of the parents earlier than the other and harvesting only the later sown line for

hybrid seed gave significantly higher yields than the other groups and also the standard and the parents.

New scheme on jowar and bajra. A new scheme for the improvement of jowar and bajra has been sanctioned in Saurashtra. The scheme is to start from 1-4-51.

Mandua *or* Nagli (Eleusine caracana *Gaertin*). In the Bombay scheme at Hatkhama two early promising strains have been evolved as a result of 6 years trial.

In the preliminary trial of twelve strains at Tarikhet (U. P.) improved types H. 120 and H. 137 showed the best performance yielding 684.5 and 647.7 lb. per acre respectively against 130.2 lb. per acre of the local.

In the mixed cropping experiments to test the relative merits of mixed cropping as against pure cropping, the more popular mixture *manduva - urd* (*Phaseoluous Mung*) and *manduva - gahat* (*Dolichos biflorus*) adopted in the hills were tried, *manduva* broadcast yielded highest, with 847.69 lb. per acre, followed by *manduva* sown mixed with *gahat* with 732.47 lb. per acre. Differences between various treatments were, however, not statistically significant.

Sawan (Panicum crusgalli). Varietal trials at the Gorakhpur centre in U. P. with five improved strains showed that type 25B has yielded significantly higher (633.71 lb. per acre) than the rest of the strains followed by strain 46B with 345.66 lb. per acre confirming its previous performance.

In mixed cropping experiments mixtures of sawan with *arhar* (*Cajanus cajan*), *jowar* (*Andropogon sorghum*) and *sawan* pure (broadcast and line sown) were tried. *Sawan* pure (line sown) gave the highest yield (378.57 lb. per acre) followed by sawan (broadcast), i. e. 312.74 lb. per acre though the difference between various treatments were not

significant. The yield of sawan was not reduced very much when sown mixed with other crops.

Kodon, Dodra or Kordi (Paspalum scrobiculatum). On the basis of yield performance in preliminary trials two of the most promising strains 11A/1 and 2B/1 were tried in a field scale test at Gorakhpur in U. P. against local. The former yielded significantly higher (1,258 lb. per acre) than the local. (1,145 lb. per acre). The scheme is to continue up to March, 1952.

Improved strains which yield considerably higher than the local are also available as a result of the previous work done in the Council's schemes in Baroda, Madhya Pradesh and Bombay. Some of these are mentioned below for information. Baroda 8 (981 lb. yield 44 per cent more than local) and Baroda 15 (906 lb. yield 33 per cent more than local) in Baroda; Kodo 13 (619 lb. per acre) in Madhya Pradesh etc.

Same (Panicum Milliare). Strains No. 33 Sira and 26 Malur in *same* group and 48 Bilichodi and 52 Hosadurga in Hejjave group have done well in trials in Mysore yielding 172, 149, 190 and 140 lb. per acre respectively at the Babbur Farm. 33 Sira and 48 Billichodi are medium maturing while the other two are late. All are drought resistant and free from diseases. In the trial of the selections at Visvesvaraya Canal Farm yields ranging from 900 to 1900 were obtained. These are being multiplied.

In the preliminary trials with mixed sowing of castor and *arhar* (*Cajanas cajan*) it was found that castor sown 6 feet apart and *same* in 3 rows (1½ feet apart in row to row) in between gave good yield. The average yield was 185 lb. *same* and 150 lb. Castor. In the mixture of Arhar and *same* on the other, the yields were 190 and 170 lb. respectively. In the mixtures neither the normal yield of *same* nor the other components were affected.

Varagu (vari) - Panicum miliceum. In Mysore, four selections have been found promising as well as drought resistant. These are 79 Chintamani, 87 G. R. Halli, 86 Chitaldrug and 78 Madhugiri. The first is an early maturing; the second a medium one and the rest late maturing. Their average yield for the last three years is gievn below :-

	Yield in lb. per acre.	
Strain	For black series	For white series.
79 Chintamani	229	235
87 G. R. Halli	217	193
86 Chitaldrug	201	204
78 Madhugiri	231	223

At the same time in the better climatic conditions and red soil of the Visvesvaraya farm they gave high yields varying from 700 to 1320 lbs. The optimum yield was obtained with July-August sowings.

In the Bombay scheme at Hatkhamba one early and another midlate vareity have been evolved.

Oodalu (Echinoloa rumentacca). In Mysore trials with 4 strains gave significant results. Of these strains No. 100 A-10 and 42 Hijapur were found to be the best yielding an average of 273 and 302 lb. respectively thus confirming the previous years' results. Similarly, as in previous years, July-August sowings gave the best yields. The improved varieties are being multiplied for distribution. Selections for fodder type from the high yielding strain No. 97 were also made for multiplication. The average yield of grain of these is also about 200 lb. per acre.

Other good fodder type selections made are 96 Coimbatore and 97 Poona which produce a good number of tillers

and gave also twice the amount of green matter as the local.

Pulses

Pulses of which India possess a large number of species and varieties form an important range of our food crops. Their area was more than forty five million acres in 1949-50 and production more than eight millions tons. They provide the much needed protein for the large vegetarian population of the country besides making significant contribution to the animal diet. They are very important in our crop rotation and mixed cropping and help to maintain soil fertility. The Council is, therefore, devoting considerable attention to their improvement by financing a number of investigations at different centres with the main object of evolving high yielding strains suited to different tracts and possessing desirable commercial qualities. More than one pulse has been taken up for investigation at each centre. The results of these investigations are given below pulse-wise and not centre-wise as in previous years. In some cases the results include those of terminated schemes also.

Bengal Gram (Cicer aurietinum)-Chena

Breeding

Uttar Pradesh. In the preliminary trial at Kalianpur (Kanpur) Type 4429 gave higher yield than other Types. In a varietal trial with 6 Kabuli gram Type 4102-2 gave the highest yield. In a varietal trial at Atarra (Banda) Type 87 gave higher yield than Banda and Atarra local. With the increase in demand for suitable legumes after late paddy grain T. 87 was tried as late as in the last week of December and was found to be successfully high yielding; large quantities of its seed are multiplied and distributed to districts for further multiplication.

Gwalior. At Ujjain centre (Gwalior) Early Sardarpur

1 and Late Chanderi 24 were found to be significantly superior to the controls. The yield was 666 lb. per acre against 251 and 242 lb. per acre of locals.

Mysore. In Mysore a few drought resistant strains have been selected.

Hyderabad. At Warangal, nine strains have yielded more than the local the highest being for strain No. 59-107-12-44.

Bombay. From the result of studies for wilt resistance and yield, it appears that the two selections, viz. (i) Chafa-Tr-1-1-4-5-11 and (ii) Dohad 206-8-1-3-6-1-2 are the best. They combine over 93 per cent wilt resistance and yield higher than local gram and the Dharwar improved strain No. 18-12.

Madhya Pradesh. Strain No. 10 and a strain from Dacca have given the highest average yield of 256 lb. and 492 lb. per acre as against 467 lb. and 435 lb. yield of E. B. 28 (control). Experiments with wheat and gram sown alone and as mixture showed that gram sown alone gave highest yield (591 lb. per acre) at Adhartal Farm while wheat sown alone gave highest yield (445 lb. per acre) at Basim Farm. As regards mixtures 60 wheat and 40 gram gave the highest yield (515 lb. mixture per acre) at Adhartal Farm and 70 wheat and 30 gram, the highest (443 lb. per acre) at Basim farm. On the basis of money value however the order is pure wheat followed by a mixture of 85 wheat and 15 gram at Adhartal farm and pure wheat followed by a mixture of 70 wheat and 30 gram at Basim.

Bihar. Three superior strains B. R. 17 (early) B. R. 65 (late) and B. R. 77 (medium) yielding 13, 13 and 11 mds per

acre have been evolved of which B. R. 77 is suited to major parts of both north and south-Bihar while B. R. 65 and B. R. 17 suited to South Bihar only.

Disease investigations

Gram wilt scheme, Punjab. Gram is one of the major crops of the Punjab, occupying about 3 million acres (2.5 under rain fed conditions and 0.5 irrigated). The major disease of gram is wilt which causes considerable damage to the crop. Investigations for controlling the disease have been in progress since 1947 in the Punjab. Conflicting theories have been put forward about the cause of the disease and final conclusions have not yet been drawn. A few simple remedial measures like deep ploughing with the help of a plough delayed sowings etc. however have been found out which help to reduce the incidence considerably.

Red Gram (Cajanus cajan) *or* Rahar

At Dharampuri (Madras) culture No. 37, which had given consistantly high yields was sent for trials under ryots' conditions in various districts and the culture found favour with the ryots in all places by giving higher yield (489 lb. per acre) than the local bulk. (39 lb. per acre).

Uttar Pradesh. Type 66 K gave higher yield than other types. Due to the increased demand for early arhar for arhar mixture three promising types, type 132. type 4107 and type 4110 have been selected for preliminary trial at Kanpur (Kalianpur). In breeding for wilt resistant 76/2-9A, 73/1-5/3 A and 78/2-5/4 have shown comparatively better resistance.

Gwalior. At Gwalior centre (Gwalior) a late variety Bijaypur 7 gave an outturn of 1131 lb. per acre against 959 lb. for control and at Ujjain centre the early strain Shivpuri 6

yielded 810 lb. per acre against 620 for control. In the mixed sowing experiments at Gwalior centre a mixture of *jowar*, *arhar* and *mung* in the proportion of 64 : 9 : 27 gave the maximum monitary return of Rs. 58/4/- per acre against Rs. 12/14/- of pure *jowar*.

Mysore. In the preliminary trial of 16 strains at Visweswaraian canal Farm the performance of eleven selection was encouraging and was superior to that of the local check ; the average yield ranging between 250-375 lb. per acre. At the Babbur Farm the following seven have done well again. Besides being drought-resistant, they do well under other inclement weather conditions.

(1) Chitalaurg, (2) Local improved, (3) Madhugiri, (4) Kunigal, (5) K. R. Nagar, (6) Korategere and (7) Chikmagular.

Hyderabad. In Warrangal (Hyderabad—Strain No. 11 was found to be superior to local.

In the yield test at Raichur strain No. 301 was found to be superior to the local, yielding 1264.6 lb. per acre, its protein content was good ; cooking time and commercial evaluation average. In another test, three strains namely 250, 270-31 and 266 were found to be superior in grain yield to the local by 6.7 per cent 4.5 per cent and 4.1 per cent respectively. The quality of these was also promising.

Bombay. In Bombay, *tur* selections F 52 and F 18 were found to be about 85 per cent resistant to wilt besides being high yielders, giving 17 to 18 per cent more than local at a trial at Arbhavi.

Madhya Pradesh. *Toor* No. 31 from among the provincial samples and Hyderabad P. E. from among the extra provincial samples gave the highest yield of 573 lb. and 446 lb.

per acre on an average as against 446 lb. and 512 lb. per acre of the conrtol E. B. 3. This yields good quality dhall too.

Bihar. The improved strains of *toor* evolved in the scheme and their average yield per acre are given below :-

Early types : B. R. 13 yields 6.2 maunds per acre

B. R. 59 yields 5.9 „ „

Medium types : B. R. 60 yields 12.6 maunds per acre

B. R. 65 „ 13.7 „ „

B. R. 71 „ 12.25 „ „

Late types : B. R. 15 yields 12.8 per acre

B. R. 78 „ 12.3 „

The early maturing varieties get ready for harvest in October after which the land could be utilized for full *rabi* crop or for double cropping in areas where irrigation is not a limiting factor. The medium strains, on the other hand, get ready for harvest in February and they are particularly suited to areas lying between Sabour and Monghyer.

Wilt and Phylloidy (Sterlity due to the transformation of floral into vegetative parts of plant) which may cause reduction in the crop yield to the extent of 40 per cent, are the two serious factors limiting increased Arhar production in Bihar. Breeding for wilt resistance is now being taken up by the State Government. Preliminary studies in Phylloidy indicated that its occurrence differs from variety to variety and from year to year in individual strains. However, it was indicated that late maturing strains particularly the erect types showed the lowest percentage of Phylliody plants, late spreading the highest and medium maturing

intermediate.

Black gram (Phaselous mungo) ulud.

Madras. At Coimbatore, strain Nos. 212 and 216 yielded 240 and 226 lb. per acre against 151 lb. of local. At Vizinagaram, culture No. 189 in the first set and No. 221 in second set gave significantly higher yields than the respective controls by 129.2 and 91.7 per cent respectively.

Uttar Pradesh. In the preliminary yield trial at Atara (Bnada) type 4467-2 gave significantly higher yield. Similarly at Kalyanpur (Kanpur) the black seeded 4418-6 was found best amongst other types. With the increasing demand of early legumes for monsoon fellow, early mung type 1 was tested against early urd types at Kanpur. The former yielded more.

Gwalior. The early variety Khachood 18 and the late variety Sheopur 17 were significantly superior, yielding 708 and 593 lb. per acre against 216 and 142 lb. per acre of the respective local.

Similarly at Ujjain centre, two strains, an early (Jora 4) and late (Bhilsa green 15) were found to be significantly superior (411 and 257 lb.) to their respective locals (229 and 226 lb. per acre of the controls).

Assam. M. K. 24F was found to be consistently promising.

Orissa. In the yield trial at Athagarh Selection 1601 was found to be the highest yielder. In the mixed cropping experiments *Beali* (very early) paddy (160 lb. per acre) plus *biri* (15 lb. per acre) were found to be significantly better than the rest and allowed by *Beali* paddy (80 lb. per acre) plus

biri (20 lb. per acre). *Beali* paddy 80 lb. per acre plus *biri* 15 lb. per acre was found to be better than paddy or *biri* grown alone. Similarly in the mixing cropping experiments at Bargarh, *Beali* paddy 60 lb. per acre plus *biri* 15 lb. per acre is significantly better than the rest followed by *Beali* paddy 80 lb. per acre plus *biri* 20 lb. per acre. *Beali* paddy 80 lb. per acre plus *biri* 15 lb. per acre is better than paddy or *biri* grown alone.

Thus the mixed cropping of paddy and *biri* is more paying than either *biri* or paddy sown alone. This experiment will be repeated in the next year for further observations.

Madhya Pradesh. *Urid* No. 55, on an average, has yielded 330 lb. as against 142 lb. yield of E. B. 110 control.

Bihar. The following four improved high yielding strains in Kali combining high dal percentage and good protein content have been evolved.

Variety	Period of maturity in days.	Average yield in mds. per acre.
BR 86	39	7.9
ST 8 (Brown seeded)	41	8.3
BR 10 (Black seeded)	43	8.3
BR 61	44	8.9

Green gram (Phaseolus aureus Roxb)-Mung

Breeding. Out of the six high yielding cultures, tried under dry land conditions at Vizianagaram selections 124, 127 and 145 gave significantly higher yield, 113.9, 118.6 and 90.7 per cent respectively more than the control while under wet land conditions at Samalkota, strain No. 188 alone gave higher than the control (13.9 per cent) for a second time.

Uttar Pradesh. In the preliminary trial at Kanpur eight types have been selected for final trial in the ensuing Kharif.

Mung type 1, the only legume which is early enough to replace monsoon fallow is being multiplied for distribution.

Gwalior. At Ujjain centre, amongst the nine selections tried, Bhilsa green which is a late strain, gave significantly highest yield of 314 lb. per acre against 181 lb. per acre yielded by the local.

Assam. The average results of two years showed that the types Mg 51 and Mg 32 were constantly high yielders.

Bombay. In district trials in East Khandesh, selections Jalgaon 23 and Jalgaon 310 proved to be significantly superior to the local.

Orissa. In Orissa, selection 150 was found to be outstanding; N. P. 18 and S28 gave significantly better results than the local mixture.

Madhya Pradesh. No 32 of mung gave 264 lb. per acre against control E. B. 160 lb. (154 lb per acre.)

Bihar. In mung, the following improved strains have been evolved Early : Black seeded. (1) (BR 2,3 and 4) yielding 5.8, 5.9 and 6.5 Md. per acre with the dhall extraction of 70, 70 and 65 per cents respectively. (2) Medium green seeded:- BR 1-5 Md.-70 per cent dhall. (3) Late, Yellow-seeded:- BR 5, BR 6, and BR 7 yields of 5, 4.8 and 5 Md. and dhall extraction of 60, 75 and 70 per cent respectively.

Physiological investigations

In the physiological investigations at Presidency College, Calcutta which concluded in June, 1950, it was found that the time required for maximum absorption of water at room temperature was sixteen hours for Kishore-gunge Sona Mung and eight hours for Mung No. I. P. 28 and that minimum

absorption of water at room temperature necessary for germination of Sona Mung was 30.5 per cent in 4 hours and for Mung I. P. 28-50.05 per cent in 2 hours.

In the time of sowing experiments, the best times for vegetative growth in order of merit for Kishoregunge Sona Mung was found to be August-September and May and for Mung I. P. 28 May, March, April and September.

In the Photoperiodic experiments, Sona Mung was found to be a short day plant and Mung I. P. 28, indeterminate or day neutral. Mung N. P. 18, was also indeterminate or day neutral as also N. P. 35.

In the low temperature (2 to 4° C) treatment for twenty one days NP 18 and NP 31 flowered earlier by one day, NP 36 earlier by 2 days, NP 23 had delayed flowering by five days while NP 35 was not affected.

In the high temperature (30-32°C) treatment for four days, Sona Mung flowered earlier by two days only than the control while mung I. P. 28 had delayed flowering hy seven days from the control.

In the field trials with NP 18, the flowering time does not seem to be clearly influenced by presowing cold treatment. In the field trials with mung NP 35, 03 days cold treatment (2-4°C) produced an earliness of flowering by three days and accelerated vegetative growth, and 45 days cold treatment produced earliness by five days. The vegetative growth was, however, much better in 30 days treatment than in the normal and 45 days treatment.

In the scheme for Cytogenetic Research on Phaseolus at Annamalai University which terminated last year it was found that the hybrid, obtained, as a result of the hybridisation

between *Phaseolus radiatus* Linn (parent : green gram) and *Phaseolus mungo* Linn (parent : black gram) combines both the characters of the male and female parents. But they are segregating into purplish coloured and greenish hybrids. The germination of the hybrids is quicker than the parents and the growth is luxuriant, the mature hybrid plant reaching a height of 65 to 75 cm. They produced greater profusion of foliage than the parents thus ensuring good fodder to the cattle, and are also highly disease resistant. They are broader, shining, smooth and olive green in colour with black marblings all over the seed surface. The number of seeds per pod increased from 4 to 12 from F 2 to the present (F 7) generation. The yield per plant exhibits an increase of 12 per cent and that of the average weight of the seed by 6.5 per cent. The hybrid seeds have been sent to the Pulse Specialist, Madras for field trials.

Horsegram (Dolichos biflorus) - Kulthi.

Madras. At Coimbatore, improved strain No. 35 gave significantly higher yield, i. e. 53.2 percent more than D. B. 7.

Mysore. At Visweswaraiah canal farm, black kulthi had been giving outstanding results constantly for the last three years. It also contained high percentage of protein (24.13 per cent against 23.88 per cent of local) and also yielded fairly well (860 lb). At the Hebbal Farm, No. 1 and Chikmagalur N. Reo, have shown promise to be good fodder types.

Hyderabad. At Raichur, three strains, 34, 36 and 33 were found to be promising, the first being the best yielder and the other two possessing slightly higher percentage of protein than the local.

Orissa. Type 27 seems to be promising as it yielded consistently the best during the last two seasons.

Lentil (Lens esculenta)

Uttar Pradesh. In a varietal trial conducted at Kanpur, 4302-14 gave superior yield to other types.

In the physilogical investigations at the Presidency College, Calcutta (1947 to 1950) the following results were obtained, in case of Lentil.

In the preliminary experiments on the time required for maximum absorption of water at room temperature by Barisal Lentil and Lentil No. 5 was 24 hours. The minimum absorption of water for 1½ hours, at room temperature necessary for germination was 50.85 per cent in Barisal Lentil and 60.5 per cent Lentil No. 5. In the time of sowing experiments, the best period for vegetative growth in order of merit was found in both these varieties to be October and November.

In the Vernilization experiments with Barisal Lentil, lateness in flowering was noted by two days and earliness only by one day from the control in 15 days treatment and 30 days treatment respectively. As regards Lentil No. 5, lateness in flowering was by 16 days in 15 days treatment and 13 days in 30 days treatment.

In the pot experiments with Barisal Lentil, cold treatment of 2-4° C for 30 days when followed by 16 hours photoperiodic treatment flowered earliest (in 28 days) and showed an earliness of 29 days compared with those treated for 12 hours of light period. The normal control did not flower. With Lentil Hyb. cold treatment for 30 days followed by 16 hours photoperiodic treatment flowered earliest in 27 days and showed remarkable earliness of 33 days compared with those treated for 12 hours light period, similar to Barisal Lentil.

In Barisal Lentil, Lentil No. 5 and Lentil Hyb-1 the presowing cold (2-4° C) treatment for 30 days had a very favourable effect both on the vegetative and reproductative growth in Barisal Lentil and Lentil Hyb-1, but Lentil No. 5 the reaction seemed to be the reverse.

Lakh (Lathyrus sativus) *Khesari*

Madhya Pradesh Selection No. 13 of Lakh gave 613 lb. average yield per acre as against 482 lb. of Jubbulpore local (control).

Bihar. Khesari is the most important pulse crop of the Bihar State as it forms more than a third of the total area under pulses. Three high yielding strains of varying habits and maturity (89-100 days) have been evolved. The early, erect types with broad leaves (BR 3 and BR 14) maturing in 89 and 92 days respectively ranged in yield from about 12-20 maunds and 12-16 maunds respectively, while the spreading type BR 13, with narrow leaves was the lastest (100 days) yielding 13-19 Md. per acre.

Four leguminous weeds, *Akta* (*Vicia sativa*), *Misya* (*V. hirsuta*) *Pipra* (*Lathyrus aphaca*) and *Lengara Khesari* (*L. sphaericus* Retz) have been occasionally noted in the *Khesari* fields of Bihar, the grains of which get mixed up with those of true *Khesari* and eaten to the detriment of consumers. In the analysis of four trade samples, in 1949, these four weeds were found to be present to the extent of 132, 0.5, 14.27 and 2.62 per cent of pure *Khesari*.

Pea (Pisum sativum *and* P. arvense) *Mattar*

Uttar Pradesh. In a preliminary trial at Kalianpur (Kanpur) 4218B-2 gave the highest yield. In a varietal trial with four types of table peas NP 29 gave superior yield. In a varietal trial with ten types conducted at Attara (Banda) Type 4218B-2 gave a better yield than other types. The seed of

type 4218 (white pea) now known as 163, was multiplied at Kalianpur Farm (Kanpur) and distributed to different circles during 1949-50.

The search for a suitable pea type for rotation with late paddy is being continued.

Bihar. In Bihar, three high yielding strains with white flowers and smooth round seeds suitable for use as field peas (Muttar) have been evolved in Pisum sativum, the early variety BR 118 and late BR 2 yielding about 10-17 and 10-19 maunds per acre respectively.

Soyabean (Clycine max)

The two schemes on soyabeans, one for the cultivation of the crop in the Punjab and the other for its biochemical assay at I.I.Sc. Bangalore have terminated. In the *Punjab* a bold seeded yellow variety, Punjab I, has been found to be eminently suitable for the hilly tracts, giving as high as 2790 lb. of beans per acre when grown under most favourable conditions. It is equally suitable for the plains provided it is harvested before dead ripe. The chief merit of this variety is that it is free from the nutty flavour characteristic of all soyabeans. The Punjab Government is arranging for the multiplication of this variety for distribution.

As a result of the biochemical investigations carried out in Bangalore, five yellow seeded varieties SB. SI. 9, SB. SI. 32 (from Mysore), Cypress, Hansu and Hongkong (from U.S.A.) which are definitely superior to others in palatability, cooking qualities, fat, protein and other characters have been recommended.

Uttar Pradesh. In a varietal trial at Tarikhet (Ranikhet) C 70 gave the highest yield. Types C 2, C 70 and C 63 were multiplied at Kalianpur (Kanpur) and Tarikhet—the first at Kanpur and the other two at Tarikhet.

Mysore. In the pre-final selections at the Hebbal Farm, SB 13, 29, 35 gave more than thousand pounds per acre yield and showed great potentiality.

Other Crops

Spices and *Condiments*

Cloves—(Travancore). Investigation carried on clove cultivation in Travancore have clearly established the need for giving shades to the plants in the early stages. The agronomic and manurial experiments have not given any satisfactory results. In view of the importance of the clove industry, the programme of work has been reorientated. Attention is to be first concentrated on establishing (either by raising seedlings in nurseries and later transplanting them or sowing the seed in Situ) the clove plantation. The manurial and agronomic trials are to be postponed till the plants are well established. The future programme will consist of :

(i) Raising nurseries and distribution of seedlings.

(ii) Collection of cloves from different regions.

(iii) Collection of information on actual yields from trees now bearing in various localities.

Turmeric—(Orissa). The following results were achieved in this scheme during the year :—(i) Sarangada produced significantly higher yield than all other varieties. (ii) Flat beds produced higher yield than the narrow ridges. This result has been found different from the last year but confirmed those of the year previous of that. (iii) The application of either ash or potash as manure for turmeric does not appear to be necessary. (iv) The combination of N,P_2O_5 and K_2O fertilizers produced highest yield of 9,376 lb. per acre. (v) Sal leaf mulch appears to confer a great benefit on the growth of the turmeric crop. Alternative treatments such as mulching with other leaves and ploughing in Sunnhemp and

Dhanicha or manuring with oilcake or compost have not proved equally good. (vi) Sal leaf ash does not increase the yield. The State Goverment have, therefore, been requested to do propaganda among the 'Khonds' on the inefficacy of sal leaf ash and futility of burning sal leaves.

Cardamom—(*Madras*). Investigations are in progress in Madras for finding control measures against pests and diseases which take a heavy toll of the cardamom industry in South India. Entomological problems have nearly been solved and breeding work is now being intensified. It has been found out that (i) cardamom thrips can be controlled effectively and economically by the use of Nicotine sulphate 0.05 per cent as spray and Gammexene D°.025 per cent as a dust. (ii) The interval between successive treatments should not be longer than a month. (iii) The results of the effect of weeding on the extent of damage caused to pods by thrips showed that there was no appreciable difference between the weeded plots but the increase was not statistically significant. (iv) The life history studies of cardamom thrips (*Taeniothrips cardamomi*) have been taken up and some progress has been made. (v) Measures to control clump rot ('Falling off') disease in cardamoms caused by *Pythium vexans* have been worked out and the knowledge gained so far shows that ammonium phosphate and superphosphate help to arrest the disease and to induce quick recovery of the diseased clumps. (vi) The data gathered so far show that nursery beds sown in July and April gave the best germination. (vii) Experiments to detemine the optimum length of sheds to be put up over cardamom.

Coriander - (*Madhya Bharat*). The wilt disease of coriander is being studied to find out remedial measures. The information obtained so far may be summarised as follows : (i) The wilt-disease of coriander is caused by the fungus identified at the Imperial Mycological Institute, Kew as

" *Fusarium oxysporium* ". (ii). The work done at the Mycological Division of the Indian Agricultural Research Institute revealed that the fungus thrives at temperatures ranging between 12° C to 35° C with an optimum of 20° C. (iii) The fungus is soil-borne and not seed-borne, attacking coriander only and is able to live in the soil for 6 to 8 years in saprophytic condition. (iv) None of the varieties or coriander collected from various parts of India was resistant to wilt. The local variety had a significantly lower wilting percentage than those obtained from other States. (v) An observation has been made at Gwalior that the percentage of wilting was very low in deep black and clayey soils.

Ginger.—(*Madras*). The object of the scheme is to undertake investigations on some or the outstanding problems in cultivation, preservation of ginger and control of the diseases that affect the crop. The studies have been started this season and hence no definite results can be reported.

Pepper—(*Madras*). With a view to rehabilitate the pepper industry in South India, which, owing to various causes, is not in a flourishing state at present and place it in a position to face foreign competition, research on various aspects of pepper cultivation is being undertaken in Madras. Only preliminary work has been carried out so far.

Chilly—(*Madras*). The object of the scheme is to evolve thrip-resistant and high yielding strains of chilly as severe losses of crop occur frequently in Guntur district due to the ravages of this pest. Previous breeding work resulted in the establishment of a strain G.I. which represented improvements over the local for tolerance to thrips, good yield (30 per cent more than local) strong calyx attachment and good length of fruit. More recently, 1402, a selection of similar origin like G. I. giving 49 per cent more yield was also evolved. Small

bulk trial under replication with nine varieties, two namely Kenedrapara and Balasore (both from Orissa) and 2150 a single plant selections from Ceylon bulk were the best yielding-49 to 60 per cent more than G I. Selection was restricted to culture having means similar to or more than G. I. for length, girth and pungency. A total of 29 plants was thus selected for resistance. Results of spacing trial concluded for the third year in succession confirmed the previous finding that increases of 40 to 45 per cent were sure to be obtained over the local method of 22" bunch planting when a close spacing of 5½" was adopted. The increases were due to earliness enabling the crop to mature much in advance of January which is the period when thrip damage is generally high on the station.

Zira—(*Rajasthan*). A new scheme for investigation on zira disease has been sanctioned which is to start from 1-4-51. Medicinal Plants—(Madras and West Bengal) : A scheme has been sanctioned for work on experimental cultivation of medicinal plants at two centres—one at Darjeeling in West Bengal and the other at Coimbatore-Nilgiri in Madras. The object is to find out the climatic and other requirements under which selected medicinal plants (which have a demand both at home and abroad) will develop optimum alkaloid content.

Fruits

Mango. As a result of Varietal trials of mango having been carried out at Sabour in Bihar, the following early, midseason and late varieties have been recommended to the public :—

Early Varieties : Surkh Burma and Alfanso (Local)

Mid-Season Varieties : Aman Dasheri, Khasulkhas; Husnara Aman Ibrahimpur, Calcutta Bombai, Aman Amanguri, Abeheyat and Sepia.

Late Varieties : Sukal, Smarbahist Chousa, and Taimuviria.

At the fruit research Station, Kodur in Madras, the Pacharsi and Hamlet (Trichury) varieties continue to lead in number and weight of fruits respectively, the latter variety gave as much as 1,001. 75 lb. of fruits per tree.

The combination of nitrogen, potassium and Phosphorus proved best in the manurial experiments at Sabour in Bihar. Furthermore, nitrogen in combination with phosphorus and/or potassium produced better results than phosphorus and potassium applied singly or in combination.

At Lucknow University, U. P., experiments were conducted to find out the cause of the black tip disease of mango and its control. It has been demonstrated that a disease similar to natural necrosis could be reproduced by direct injection of necrotic mangoes. Furthermore, the healthy mangoes developed symptoms of necrosis when brick kiln fumes were passed through them.

Studies on the Gall makers of mango leaves and shoots were continued in the plans of U. P. In addition to nine types of galls, eight on mango leaves and one on shoots, reported last year, three new types, two on leaves and the third on the inflorescence of mango were discovered. The Cecid causing flat galls is *Procontarinia matteiana* Kieff and Cecc. The species of Cecid flies reared last year from the green, slaty and brow globular galls were identified as *Amraemyia viridigallicola* Rao, *A. Amraemyia* Rao and *A brunnei-gallicola* Rao, respectively, and from the brown echinate gall as *Amradi-plosis echino-galliperda Mani.*

At Poona, the cytogenetic studies of root tips of mango plants fined in Langlet's fluid showed more dividing cells

than those fixed in Lewis tky's fluid which is evidently due to the omission of acetic acid from the latter fluid.

Citrus. With a view to find out the best varieties, suitable stocks and scions, quick and cheaper methods of propagation, and suitable cultural methods for citrus species, various research schemes are in progress in Madhya Pradesh, Madras, Assam, Orissa and Coorg with the following results.

1. The vigour of santra trees in Madhya Pradesh as indicated hy the increase in sten girth, revealed that stock Jamberi and sweet lemon were associated with vigorous growing trees whereas the sour orange had the dwarfening effects.

2. As a result of the intensive work having been conducted in Assam on the economical characters of citrus species grown there, a large number of species and varieties have been described in a monograph which is under publication.

An experiment has been laid out in Orissa to study the comparative commercial output of some promising varieties of sweet orange as compared with the local variety of Nagpur Santra.

Experimental material has been prepared in Coorg to test (a) the suitability of budded plants as compared with seedlings normally planted and (b) to evolve suitable stocks for Santra trees commercially grown in the State.

At the fruit Research Station Kodur in Madras, the Hawailam Pummelo among the citrus varieties continues to yield big-sized fruits. Further more, the percentage

of attack by the fruit sucking moth on sweet oranges was reduced to half by spraying with 0.1 per cent solution of D. D. T.

A survey of orchards comprising 2487 acres was undertaken at Waynad with special reference to the nature and extent of damage caused by the (Cerambycid) borer. It was found that all the citrus varieties except the pummelo were affected by this borer.

The incidence of decline of orange trees at Waynad was found to be influenced by condition of orchards and the nature of the soil. Gardens in exposed situations and liable to erosion exhibited more of the disease. Application of manures and provision of mulch covering to the soil round the base of the trees resulted in improved flush.

The work conducted on Citrus Leaf Miner in U. P. showed that the maximum dose of Potassium-cyanide which a citrus tree of 2-3 ft. height could tolerate was 0.6 gm.

Banana.

Varieties of banana found suitable at Sabour for Bihar conditions are Malbhog, Dudhsager, Sakarchina, Champa Satya, Harichhal, Bagnar, Bombai Red and Rai Kela.

The cytogenetical studies at Poona in Bombay of three sub-genera of Musa, (1) S. G. *Physocaulis*, (2) S. G. *Rhodochlamys* and (3) S. C. *Eumusa* revealed that all these have different chromosome numbers. S. G. Physocaulis has 2n=18. S. G. Rhodoch-lamys 2n=22 or 22+1 f, and S. G. Eumusa has two district series 2n=22 or 22+ I f and 2n=30 or 33+ I f.

At Calcutta University, Calcutta in West Bengal, a

scheme is in operation which aims to explore the possibilities of improving the cultivated bananas of India by breeding new types with new genomic constitution. Work under the scheme is in progress.

With a view to effect improvement of banana, by introducing improved varieties and evolving better cultural practices, a scheme for the establishment of Banana Research Stations in Madras with Sub-Station in Bombay and West-Bengal has recently been started.

Apples, Pears, and Plumes, etc.

The following varieties of apple, pear and plum were found important from the commercial point of view in Kashmir :-

Apple :- Late-Season Varieties : Nawabi Turash (King of the pippins) and Lat Zuth Lal (Dutch Migroune). They possess good keeping qualities.

Early-Season Varieties . Among tbe crabs, Janbazpuri Trel (John Dowine) is commercially important which is an early variety. Nmoh chuk Trel and Hapat Trel are good for seed extraction for stock raising as these contain plump seeds.

Pears. Among the pears, farause Gosh-bugh (Beuree Baltet Pere), Kagzi Nakh Kalan (clapps favorite) from mid season pears Bor Fransi tangh (Marchal-De-La-cover) from late season pears are commercially important and are recommended for extensive cultivation.

Plumes. Four new varieties have been collected during this year which makes the total number to 31.

A new scheme has been sanctioned in Himachal Pradesh which deals with (a) the collection, introduction and the study of different temperate fruits particularly apples, pears, plums, peaches, apricot, walnuts, almonds

and grapes under different climatic conditions : (b) the multiplication and distribution of varieties found suitable for different climatic conditions and (c) the study of floral biology and self and cross incompatibility of varieties.

Custard-apple. Red custard apple and the Mommoth district varieties of this fruit in Hyderabad. Exotic varieties namely Barbados and Washington p. 1.9879 have given higher yields than the local sorts.

Grape-Vine. Bhokri is the highest yielder and has proved to be a hardy commercial variety in Hyderabad. The Anab-e-Shahi variety has also proved to be a good croper as well as a good quality grape in the above state.

Litchi. In Bihar, Purbi is the best yielder and Kasba comes next in order.

Papaya. The following strains are resistant to virus diseases in Bihar :-

Ranchi, Sabour 2 and Sabour 3.

Cashewnut. Cashewnut has proved to be a dollar earing crop. The U. S. A. is by far the greatest importer of Cashew-nuts and 98 per cent of its total imports is of Indian origin. Therefore, the Council has sanctioned a coordinated scheme for extending its cultivation and to improve the yield status of the existing plantations.

The main Research Station will be in Madras and the two sub stations will be in Bombay and Travancore-Cochin States.

Fruit Preservation

In order to encourage fruit preservation on home scale, the Council has sanctioned schemes in U. P. and Bihar. The aim of these schemes is to provide short courses

of training in fruit preservation for the benefit of ladies belonging to private families as well as to other interested parties.

New schemes :

The following new schemes started functioning during the year :-

1. Scheme for manurial trials on citrus fruits, Punjab.
2. Establishment of a station for carrying out research on fruits in the plains of U. P.
3. Horticultural investigations at Chaumbattia, U. P.
4. Mycological and Entomological investigations at Jeolikot, U. P.
5. Scheme for research on the increased production of tomatoes, potatoes and other vegetables by the application of hydroponies, flower extracts and growth promoting substances, Banaras Hindu University, Banaras.
6. Scheme for starting a training centre in fruits and vegetable preservation, Assam.

Vegetables

The following three schemes were sanctioned during the year :—

1. Scheme for the improvement of vegetables, Bombay.
2. Scheme for the improvement of Vegetables, U. P.
3. Scheme for the improvement of Vegetables, Travancore-Cochin.

The object of these schemes is to study various aspects of research covering improvement of varieties, breeding of new varieties, improvement in cultural methods, manurial requirements and control of pest and diseases. The Government of Bombay and Travancore-Cochin have not yet taken up the schemes due to financial stringency.

The following schemes are in progress and brief description of each is given below :—

Scheme of research on tuber crops, Punjab. This scheme was started on 24th September, 1949 and was continued only to two tuber crops viz. Calocacia (Arvi) and Sweet Potato. Important varieties of these tuber crops have been collected from different parts of the State as well as from other parts of the Union for trial purposes. The work is in progress.

Scheme of research on tuber crops, Bombay. The scheme was started on 1st September, 1949. The object of the scheme is to improve tuber crops like sweet potato, tapioca, alu and yam and to try other tubers like Koorka. Important varieties of some of the tuber crops have been collected for trial purposes.

Similar schemes for research on tuber crops are in progress in Madras, Bihar, Orissa, Mysore and Travancore-Cochin whose progress reports are awaited.

Fodders and Grasses

Scheme for the improvement of pasture grasses and legumes. (I. C. A. R.)

A model scheme for improvement of pasture grasses and legumes drafted by the Indian Council of Agricultural Research, the details of which were given in the last year's report was circulated to all the States in Schedule "A" and "B" and they were asked to submit schemes on the lines indicated in the Model Scheme with such modifications

as might be necessary according to the local conditions. Schemes from the Governments of U. P. Punjab, Bihar and Bombay have been received. The first three States have requested the Council to meet the full cost of the scheme where as the Government of Bombay have agreed to share the cost on 50 : 50 basis. These schemes will be considered by the Research Board of the Council at its next meeting.

Combined Scheme for the Description of Important Varieties of Fruits grown in India and Abstraction of Horticultural Literature

The following items of work connected with the scheme were attended to during the year under report.

Description of important varieties of Fruits grown in India comprised.

(1) Description of the tree, flower and fruit characters of mango varieties recorded during the previous year's flowering and fruiting seasons were verified and descriptions of 24 additional varieties were collected during the tours to the different mango growing centres during the year.

(2) necessary colour sketches of fruit Specimens of the different mango varieties were prepared.

(3) complete morphological descriptions of about 190 important varieties of mango were recorded.

(4) numerous synonyms in the existing nomenclature of mango-varieties have been noted.

(5) history of the origin of the varieties has been recorded wherever possible.

(6) work on mangoes has been completed and a detailed report has been prepared.

Abstraction of the Horticultural Literature

About 700 abstracts, summaries, extracts from about 200

journals, bulletins, leaflets, circulars and books published in India and foreign countries were taken. Out of these, about 500 abstracts were cyclostyled and circulated among 250 horticultural workers in the country upto May, 1950. From June, 1950; these are being published in the "Indian Journal of Horticulture".

In accordance with the wishes of various research workers, the abstracts were arranged under the headings : tropical fruits, citrus and sub tropical fruits, temperate fruits, small fruits, vines, and nuts, miscellaneous, plant protection and diseases, storage, processing and the plant products, vegetables and other crops and floriculture.

Care was taken to include in the abstracts, wherever possible, the *modus operandi* followed by research workers for the benefit and guidance of all concerned.

Village Rehabilitation Scheme, Baroda

This scheme which was undertaken to study the economic results by observing influence on the cultivators themselves of different forms of landtenure and farming on leased tenancy, proprietory collective and cooperative basis, showed that proprietory system yielded the best results and next to it came the leased tenancy system and then the collective system, while the co-operative system stood last. As a rehabilitation scheme it proved quite successful. All the agricultural improvements viz. manures and fertilizers, improved seeds, improved implements etc. were introduced in the scheme villages.

Soil Science

Scheme for Research on minor and trace elements being carried out at the I. A. R. I. has yielded further useful results. As a result of the analysis of the soil profiles collected from Coorg it was found that the soil, at any depth is

deficient in K_2O, P_2O_5, and CaO, and that the deficiency of Nitrogen and Organic matter could be made up by the application of Farm Yard Manure. The soil was however rich in soluble P_2O_5, Fe_2O_3 and AI_2O_3 specially at 17" to 32" layer. They were also found to be deficient in Mn content thereby causing the deficiency diseases of citrus grown there. But the total quantity of Zn and Cu were in abundance in general in all the horizons. Concentration of total ash, MgO, Ca, Fe, Zn, Cu etc. was higher in all the healthy samples of plants of Coorg. The soils from Punjab especially those from Attari are poor in organic matter—there being no difference, however, in the amount of this constituent in healthy and diseased areas either at Jullundur or Attari. The Coorg and Punjab Soils were both found to be low in total base exchange capacity. The ash and CaO contents were more in healthy samples than in the diseased ones in Coorg as well as in the Punjab. From an observation made from healthy and diseased leaves of Santra and malta obtained from Ferozepur it was found that healthy leaves contained more of Calcium and Zinc than the diseased ones. The scheme is still to continue for a period of two years to reach conclusive results.

Soil Science. Scheme for the trial of Indian Pueraria species and for investigations on factors influencing flowering and seed setting in Kudzu Vine.

Comparative morphology and growth rate of three species of *Pueraria*, viz. (*P. tubeross*, *P. Phaseoloides* and P. hirsuta) collected from different parts of India were studied and compared with those obtained from abroad.

Three different agronomic treatments were given to determine their effect on flower formation and seed setting. These treatments (Staking, defoliation and watering) have given no response so far.

The stock plant first started flowering after three years and subsequently twice a year thus confirming a normal occurance of bi-yearly flowering of Kudzu Vine. Stock seeds were scarified by sandpaper to improve the germination percentage and were distributed to eleven centres for trial purposes.

Scheme for nitrogen fixation in soil. I. A. R. I. It has further shown that whereas inoculation of gram seeds with pure isolated bacterial cultures produced few nodules, treatment with black soil gave good results. It was observed that incorporation of 1 per cent, black soil in the red soil in the pots increased the yield of dry matter and its nitrogen content by about 50 per cent. In the field experiments the plots treated with black soil gave on the average 45 per cent higher yield of grain than the control plots. Nodulation studies on Rahar confirmed the previous field observations that nodules are formed on Rahar in the first twelve weeks of its growth. Further experiments on gram and Rahar crops are in progress.

The scheme on soil erlsion at Vishwabharati which was due to terminate on 31st March, 1951 was carefully examined by a Sub-Committee. It has been decided that since many useful results were obtained by experiments and trials in the laboratory, it was desirable to put these experiments on the 68 acres of land directly under the control of Vishwabharati. In order to achieve this the scheme has been given one year's extension after which period it is expected to be taken up by the West Bengal Government in their comprehensive Developmental Scheme now under consideration. Another scheme on soil conservation has been sanctioned this year in Himachal Pradesh, the object of the scheme being to undertake ecological survey, cultivation of soil binders, find out suitable measures to reduce soil losses and to determine the right texture of

soils for the cultivation of different agricultural crops. A new scheme for *"Research On Azatobactor Inoculation Of Crops"* has been sanctioned in West Bengal, the object of the scheme being to find out the effect of inoculation of the seeds of cultivated crops like Rice (*aus*), Potato and jute, with azatobactor on the growth and yield.

A very important and coordinated comprehensive scheme prepared and sanctioned by the Council this year is for Manurial experiments, based on the recommendations contained in Dr. Stewart's report on soil fertility investigations in India with special reference to manuring. The scheme has been sanctioned in a few selected states to start with. The main features of the scheme are :—

(a) The simple trials will be conducted on the cultivator's fields on the basis of geographical units, the treatments being superimposed on the cultivator's practices in randomised blocks and in consultation with the staff already provided by the centre for crop cutting trials. The number of treatments is to be restricted to three crops only and not more than 50 experiments are to be undertaken in each crop. The different states so selected have been assigned the following crops to start the experiment with :

Madras : Two crops of paddy only in one district.

Bombay : Paddy and wheat in one district each.

West Bengal : Aman paddy and Jute.

Orissa : Paddy and Pulse or paddy alone if two crops of it are grown.

Bihar : Paddy and Jute.

The schemes are to be put in operation during 1951. It is expected that at the end of 3 years sufficient data will

be available with the Agricultural departments to enable them to formulate and recommend manurial schedules to the farmer with confidence. Since the experiments will be on cultivator's fields they will be effective as demonstrations thus helping to bridge the gap between laboratory and field.

(b) An exhaustive soil survey is to be conducted in the district selected for the above experiments, and for analytical work the international method is to be adopted. The Soil Surveyors appointed for this work will be given three months training at the IARI. The idea is that the entire District will be soil mapped at the end of 3 years.

Botany and Cytology

Scheme for research on Cytology and Plant Physiology at Almora

Mustard. The preliminary experiments so far carried out indicate that by soaking seeds of mustard T. 102 in water extracts of leaves of vernalised plants the leaf stage at which the first flower opens can be reduced, but no earliness in emergence of flower was observed.

Wheat. The results of the previous year that by closer spacing higher yield of wheat can be obtained from vernalised seeds was confirmed.

Barley. It was observed that unlike vernalised seeds of wheat which showed a lower percentage of germination compared with controls, the percentage of germination of control and vernalised seeds of barley C 293 was very similar.

Plant Introduction Scheme I. A. R. I.

A total of 1250 samples of various plants were added from foreign countries to the existing material during the year. In the harbarium, 50 specimen collected from South

India were mounted and preserved. 41 varieties of sweet potato, 15 of tomatoes, 46 of groundnut and a number of millets' and vegetables were distributed to the various States for trial during the year.

Scheme for investigation of Physiological and Biochemical changes induced by Pre-sowing Hardening treatment of crop seeds-Delhi University.

(1) There is an accelerating effect of pretreatment with water as well as with 0.1 M solutions of sodium Chloride, Calcium Chloride, Potassium Nitrate and Potassium Chloride on the rate of germination and seedlings growth of wheat seed.

(2) Pre-treated seed absorbs moisture from the atmosphere more quickly than untreated seed inspite of the fact that their water content is slightly higher after pretreatment than that of untreated seed.

(3) This increased hydrophily of pre-treated seed is confirmed by earlier germination of pre-treated seed on atmospheric moisture alone.

Insect Pests, Fungi and Weeds

Test with DDT and allied insecticides were continued at the I. A. R. I., Bombay and U. P. those at Madras were completed. The effects of these insecticides on different pests tried are given below :

Paddy

(a) *Grasshoppers.* Field trials in Bombay State with different concentrations of BHC against the paddy grass-hopper and Deccan wingless grass-hopper (*Colemania sphenarioides*) were conducted round about Belgaum and Dharwar respectively. These trials confirmed that 5 per cent BHC (0.65 per cent gamma isomer) in the form of Gammexane, Hexyclan or Hexidole when dusted at the rate of 15-20 lb. per acre,

gave a complete control of paddy grasshoppers. With regard to Deccan wingless grosshoppers on jowar, however, a higher concentration of the same proprietory compound containing 10 per cent BHC (1.30 per cent gamma isomer) when applied at the rate of 25-30 lb. per acre yielded a significant reduction in hopper population. Preliminary trials with 10 per cent BHC dust mixed with 50 per cent Chlordane in the proportion of 20 : 1 against the same pest have yielded very encouraging results particularly in case of older instars.

(b) Paddy thrips (*Thrips eryzae*). Trials in Madras State with DDT and BHC sprays at 0.25, 0.10 and 0.05 concentrations and tobacco decoction (1 in 6) indicated specific action of BHC spray even at 0.05 per cent concentration. The probable requirements to treat an acre may be about 100 gallons of the spray fluid costing about Rs. 8 to 10.

Jowar pests

In U. P. against the third and fourth instar nymphs of Kharif grasshoppers (*Hieroglyphus Banian*) on *jaur* crop, 5 per cent Hexyclan dust at 20 and 10 lb. per acre proved more effective than sodium fluosilicate-bran-molasses bait (1 : 20 : 2) at 40 lb per acre, the percentage production in the population of the nymphs in the three cases being 95, 65 and 53 per cent respectively, within 36 hours of the application of the treatments. On the other hand, 5 per cent DDT dust and 1 per cent suspension at 40 lb. and 15 gallons, respectively per acre were less effective and more costly than 5 per cent Hexyclan dust at 20 lb. per acre.

(b) *The cholam earhead bug* (*Caleceries angutris L*). In Coimbatore (Madras State) DDT and BHC even at a low strength as 2 per cent can control this pest resulting in increased yield. Of the two, BHC is more promising as judged from the cost of treatment and quicker knock-down effect. The quantity of the chemical required to treat an

acre may be about 30 to 40 lb. costing about Rs. 6 to 8 depending on the severity of the infestation. It was also noted that the Chithari cholam, if sewn before 15th March under Coimbatore conditions completely escapes the infestation.

Vegetable pests.

Aphid—(a) Cruciferous vegetables. Since 5 per cent BHC dust in the form of gammexana of Hexyclan imparted a disagreeable odour to cruciferous vegetables, a new proprietary compound of pyrethrum namely Pyrocolloid was tried in Bombay State against aphida on cruciferous vegetables. The results of both Pyrocolloid (1 : 1000) and nicotine sulphate 40 per cent (1 : 800) were almost at par.

In a laboratory test in U. P. against the nymphs and wingless adults of mustard aphis (*Siphocoryne indobrassicae*) on leaves of turnip, 0.1 per cent benzene hexachlorine suspension, 5 per cent Hexyclan dust, nicotine sulphate (1 : 600) 1.5 per cent soap emulsion and 5 per cent DDT dust proved very effective, the percentage mortality of the ephids 4 days after the application, being 98.7, 94.3, 93.7, 88.3 and 87.0 respectively. In treatments 0.1 per cent DDT suspension, 0.5 per cent soap emulsion and no treatment the percentage mortality was only 29.0, 9.7 and 6.0 respectively. The dusts end sprays were used at the rate of 350 milligrams and 5 cc respectively per sq. foot of leaf area.

b. Chilly thrips (*Setroothrips dorasalis*)-DDT and BHC at 3, 4 and 5 per cent concentrations Nanjanad clay and tobacco dust were the variants tried in Madras State. The two chemicals at 5 per cent concentration effectively controlled the pest resulting in increased yield. Usually one application was found enough but a second one may be neccssary in particularly bad season. BHC D.025 is recommended because of its lower cost, the quantity of the chemical required may be 25-30 lb. costing about Rs. 8.

c. Bringal beetle (Epilachna sp). Experiments in Madras State with DDT and BHC dusts at 3-4 and 5 per cent as sprays at 0.25, 0.10 and 0.05 per cent Calcium arsonate dust and spray and Nanjanad clay showed the efficacy of DDT was equal to that of Calcium arsenate.

d. Red pumpkin beetle (*Aulocophora Fovelicollis*). Significant reductions were brought about in the population of the pest by DDT and BHC dusts and in the percentage of damaged leaves by all the insecticidal treatments in U. P. The percentage moratality among the seedlings was significantly less in the DDT and Pyrodust treatments.

e. Singhara beetle (*Galerucella Birmanica*). Gammexane D. 025 at 100 lb. per acre was effective in U. P. in killing the grubs of the singhara beetle damaging leave of singhara vines.

Fruit pests.

(*a*) *Mango hoppers.* Comparative trials in Bombay State with the further dilutions of 5 per cent DDT-sulphur namely 1:1, 1:3 against mangohoppers yielded cent per cent reduction in hopper population, but the residual effect in case of 1:1 proportion was more than 15 days and that of 1:3 was less than 10 days.

b. Mango mealy bug. In U. P. application of a 6 inch wide sticky band of rosin and castor oil (50:50) on the stem, nine times at weekly intervals, proved very effective in deterring the nymphs of Mango mealy bug from going up the mango trees the sticky band, however, did not remain effective for more than a week.

House fly-

A single application of Gammexane D.025 at 150 lb. per acre of the surface of the heap, remained effective in killing over 75 per cent of the adult emerging flies for about a week in U. P.

Storage pests, Punjab.

With a view to studying the losses caused by insect pests, representative samples of stored wheat were taken from the godowns of the Punjab Civil Supplies Department in eight districts representing different climate conditions in the state. Representative samples of wheat were also taken from different kinds of receptacles used in the villages of those very districts. The findings are that the average percentage of damage in the Government godowns and those of the Zamindars was 9.69 and 1.97 respectively. The number of insects per seer sample of wheat was, on an average, 102 living and 666 dead in the Government godowns as compared to 47 living and 37 dead insects in the village stocks. It indicates an urgent need for improving the methods of storage adopted at present.

With a view to exploring the possibility of fumigating stocks of wheat in godowns which cannot be made air tight, fumigation with Methyl Bromide was tried under a locally manufactured tarpaulin. The insect mortality was 100 per cent. The treated grains showed no residue to bromine on chemical examination and the germinating capacity too was unaffected. The cost of fumigation is 1/15th as compared to the cost with killoptera.

Samples of wheat and gram were collected from the threshing floors in five districts and they showed no infestation indicating thereby that the insect attack does not start in the fields under Punjab conditions.

Plant virus.

A coordinated scheme for the study of fundamental problems on virus has been sanctioned for five years. Under this scheme the existing virus station at Poona will be continued and two new stations set up at Delhi and Simla.

The results under the existing scheme the following :

(i) Virus imbibed by the nymphs of white fly while feeding upon diseased leaves of bhendi has no effect on subsequent emergence of the insects.

(ii) In fields where regular rogueing of diseased plants was carried out, only 6 per cent of the plants became diseased while in an untreated field the disease spread rapidly and towards the end of the season 67 per cent of the plants were infested.

(iii) Flea beetles breeding on sunn-hemp plants in nature failed to transmit the mosaic virus.

(iv) *Myzus persicae* transmitted the virus to 12 out of 36 plants inoculated, while transmission with *A gossypii* was very low. *A neri* failed to transmit the virus under similar conditions.

(v) *"Katte" disease of cardamom*—Experiments carried out at Sirsi show that winged as well as wingless viruliferous adults of the aphis *Pentalonia nigroneravosa* completely lost their virus content when fed on a healthy bababa plant.

(vi) Virus is readily transmitted by the white-fly, *Bemisia tabaci* but is not related to the virus causing yellow mosaic of *Phaseolus lunatus.*

Schools of research in Entomology and Mycology

Schools of research in Entomology, U. P. Agra and at the I. A. R. I. continued. The schools on 'Jassidae' under the P. P. A. and 'Mites' in the Madhya Pradesh have been postponed. Three new schools (i) Synthetic insecticides (ii) white flies and (iii) Physiology of Parasitism have been sanctioned. These schools are likely to start shortly.

Weed control by chemical methods.

A coordinated weed control scheme has been sanctioned. The scheme consists of two parts (i) Central, consisting of manufacture and synthesis of indigenous chemicals and distribution of suitable ones to states for trial and (ii) Regional Actual testing of tried materials in the field to control and eradi-cate weeds.

CHAPTER III—ANIMAL HUSBANDRY

Livestock Breeding

Cattle breeding

The Livestock Investigation Scheme continued to function at Hissar. The main object of the scheme is to find out whether by a process of scientific breeding, the two important economic characters in Hariana cattle i. e. milk production and 'draught ability' can be suitably combined to evolve dual purpose type animal which would best serve the needs of the country. So far, detailed information about milk yield, calving interval and age at first calving of all the experimental animals has been recorded. Reaction time i. e. the time interval between the bringing of the bull to a cow and the actual time of service has been observed and on an average this was found to be 24 minutes and 29 seconds. Draught ability trials have, however, been discontinued as the previous work had given no conclusive results. The average calving interval has been found to be 500.64 ± 11.52 days. Effect of feeding different feeds on frequency of oestrum has also been studied.

In Madras State at Palayakottai a similar scheme is in progress with an object to improve the milking qualities of the Kangayam breed without lowering its draught ability. In this scheme proper assessment of the results was handicapped due to continued famine conditions which affected uniform feeding. Due to feeding difficulties the average age at first calving of the heifers was also comparatively high. In experiments, effect of under massage of pregnant heifers was studied and it was observed that as a result of such treatment in more than 80 per cent cases the heifers gave a higher yield of milk and also had a longer lactation period. In the

foundation herd, however, 66 per cent of the cows yielded over 2000 lb. per lactation. To overcome the difficulty of getting sufficient males for testing the qualities of milk and draught ability it has now been decided that all the male calves produced in the experimental herd should be purchased by the Council and the Madras Government and half of these should be castrated and tested for work while the other half used for testing milk qualities by observing the milk yields of their progeny in the herd itself and elsewhere where records can be maintained. The feeding problems is to be solved by providing 50 per cent of the feeding expenses to the Pattagar by the Madras Government and Council and it is hoped that it will now be possible to maintain the dams and progeny on a uniform plane of nutrition.

At the I. D. R. I., Bangalore, the scheme for using milking cows for work continued to function satisfactorilly. The object is to investigate the possibility of using milching cows for light work, without adversely affecting reproduction or lactation. Sindhi cows are being used for the experiments. The data obtained will be statistically analysed for drawing valid conclusions.

The scheme to study the influence of marketting and insurance on cattle improvement in villages in Patiala progressed satisfactorilly. The object of the scheme is to study the effect on cattle improvement of providing facilities for the marketting of milk and for the insurance of cattle against unforeseen deaths. Provision is also made to replace stock with better animals and for their breeding with better bulls. Economic surveys conducted at the beginning of the study and periodically thereafter will show the influence of the scheme on the economy of the villagers. Under the scheme 136 good Murrah buffaloes have been given on taccavi loan which is returnable. The milk from these animals is being collected and sold in milk depots in the city and to cover

losses due to death of animals a ten per cent premium on the selling price of milk is recovered from the producer. The scheme has now functioned for two years and the utility of the scheme well demonstrated by the demand of adjoining villages for its expension and in the increased earnings of the villagers included in the scheme.

The F. A. O. Conference on Cattle Breeding under tropical and sub-tropical conditions held at Lucknow in February, 1950 pointed out that no authentic data was available about the behaviour of Indian cattle under adverse climatic conditions. The truth of it was recognized and the Council has sanctioned a scheme to study the physiological genetics of Indian breeds of cattle under adverse environmental conditions. This scheme will function under the I. V. R. I. with the headquarters at Harringhata Farm in West Bengal. In this scheme it is intended to try out a number of well known breeds viz. Sindhi, Sahiwal, Tharparkar, Hariana and Gir which are of all India importance.

The Council has sanctioned financial assistance to the Bombay Government for definition of breed characteristics of Dangi and Nimari cattle and Mehsana Buffaloes.

The Central Herd Book Section continued to do useful work in connection with the registration of animals of the recognised breeds of cattle in the Herd Books maintained by the Council. The total number of animals registered during the year was as against in the previous year.

Of the three units of Pilot Key Village Schemes sanctioned by the Council to continue in Delhi, U. P., and Travancore-Cochin the first two were started during the year and all arrangements were in hand to start the third in Travancore-Cochin from 1-4-1951. In all there provision has been made for breeding by Artificial Insemination as far

as possible in order to effect economies in bulls and to make the widest possible use of bulls of high merit. It is too early to comment on the progress made so far as the two units were started early in December and January.

Sheep Breeding

The Council has been sponsoring, various schemes for the development of sheep and wool in the country since 1936, and it was felt that as sufficient experience had now been gained, work on a larger scale should be undertaken. To develop the good quality wool rapidly in the tracts considered most suitable, a scheme for the improvement of sheep and wool on regional basis has been sanctioned. For the purpose of the scheme the country is divided in three regions, viz. the temperate, Dry Northern and Deccan plateau. In the first region it is proposed to use the Rambouillet rams imported from America and also to carry out experiments on selective breeding. In reigon No. 2 selective breeding is proposed ; while in region No. 3 both selective breeeding and cross-breeding with Rambouillet rams will be restored to. Each region is to have a main centre plus a wool analysis laboratory along with a sub-centre.

The Bombay sheep breeding scheme has been extended for one year or until it merges with the regional plan whichever is earlier. Much progress could not be made to further study the adaptability of the Merino to Deccan environment as no new rams could be imported and the existing ones were very old. Cross breeding of Deccan sheep by Merino was carried out at the Poona Farm and at the Sheep Breeding Research Station, Nagariale. At the wool Research Laboratory Poona, study of the fleeces of Patanwadi breed of sheep and the effect of age on wool quality was continued, while studying the fleece density and its relation to the fibre diameter and its variability it was observed that higher the fleece

density the smaller is the mean fibre diameter and thus it was observed that the fleece density was a very important characteristic because the selection of higher fleece density would yield a fleece with finer fibre diameter.

The work under the indigenous sheep breeding and wool analysis scheme at Hissar (Punjab) which has for its objects, the evolution of a fine woolly type sheep from the existing flock by selective breeding and to study the maintenance of the flock on economical basis, had reached a stage where it may be said that results had been almost achieved. However, some work regarding the decrease in size, weight, fertility and milk yield still requires to be looked into and for this the scheme has been extended for a period of six months. At the wool laboratory attached with this scheme, work on the standardisation of Bikaneri wool and analysis of wool of the stud rams used was carried out to help in selective breeding of sheep and it was found that two of the rams possessed wool fibres upto 90 per cent.

In the Kashmir sheep breeding scheme Banihal has been extended till it merges with the regional plan. Although due to political situation in Kashmir this scheme had received a set back owing chiefly to the experimental flock having been taken away by the raiders, the work has now been recognised as a good numbers of original flock has been recovered and three Rambouillet rams and three ewes and one Daline Merino have been imported from America. Inspite of lack of necessary facilities, much improvement has been noted in the artificial insemination experiment at this farm and the percentage of conception in ewes has been more than 66 per cent.

The scheme for the survey of breeds of sheep in Rajasthan revealed that there are 8 types of sheep in that area and from wool point of view they have been classified into

3 main types, short staple, medium staple, and long staple. To evolve a white woolly sheep by grading Ballary ewes with Bikaneri ram, the work on Sheep Breeding Scheme, Madras was carried on during the year under report.

Goat Breeding

Goat breeding scheme, Orissa. During the year under report more time and energy has been spent in the control of diseases like contagious caprine pleuropneumonia and encephalomyelitis which upset the breeding work. Study of the effect of Beetal blood in F1 and F2 progeny has shown that the F1 kids have inherited more characteristics of their sires than their dams in respect of ear, face, horn, nose, colour, size, etc. and these characteristics have been more intestified in the F2 progeny.

As there had been a successive decrease in the size and weight of the progeny produced by crossing Angora and Punjab hill goats, the scheme of Angora Goat Breeding was shifted from Hissar in Punjab to the hills in Uttar Pradesh and it is hoped that with better climatic conditions, desired improvements, both in the production of Mohair and size of the progeny will be achieved.

Poultry Breeding

Under the Madhya Pradesh Poultry Development Research Scheme feeding trials were conducted with tarota seeds, mango stone kernels, and *mahuva* refuse. Of these *mahuva* refuse did well as poultry feed both for growing chickens and laying flock. The average egg production per bird from October to March was uniformly going up for both the White Leghorn and Rhode Island Red grades. Desis did not record any increase in number and size.

Fertility, hatchability, longevity and disease resistance

under farm conditions were also studied. Fifty cocks of improved breeds ware distributed in the rural experimental units. In the rural areas about 45 per cent of the total production of eggs is consumed in the villages. The stuff make frequent contact with the people who are very impressed with their useful work.

At the Indian Veterinary Research Institute a scheme for investigating on the helminth parasites affecting poultry was sanctioned, the object of which is to investigate the factors controlling the resistance of poultry to helminth parasites and also to study the viability of their eggs with a view to find out suitable measures of control. Preliminary experiments were performed for investigating into the age resistance of chickens to *Ascaridia galli* and *Heterakis gallinae*, the two commonest roundworms of the poultry. It was seen that chickens 14 weeks or more in age develop a very high resistance against these parasites. Detailed studies have been made on the embryonic development of these parasites.

Extra corporeal hatching in cultures were very frequent both in *Ascaridia galli* and *Heterakis gallianae* egg cultures. The hatched larva is very active and remains alive upto 72 hours. In most cases a moult occurs soon after hatching.

Studies have also been made in (i) segment counts as a test for determining the number of worms inside the intestine, (ii) the periodicity of segment dischaged and (iii) the effect of crowding of the worms inside the intestines of the host on the size of the worms.

Studies on the effect of moderate doses of tapeworm (*R. cesticillus*) infections on very young chickens are in progress.

Dairying

Quality, improvement in milk and milk products and its costing.

Under this scheme at the Agricultural Institute, Allahabad, now running in its third year, 423 samples of milk were studied for specific gravity, acidity, fat test, sediment test, alizirol test, Methylene blue test and litmus milk test. The results of these tests, when studied with reference to the various methods of handling milk, will give indications of the effect of the various processes on quality. No changes in the costing procedure have been made.

Two new methods of minimizing adulteration of milk on the delivery routes were studied and both proved effective. One consists of fitting the delivery can with an additional hood and the other is to fix and seal the can to the delivery cycle so that the can cannot be removed.

Fluorescence analysis of ghee in Ultra-Violet light

As a result of this study on ghee at the Deptt., of Biochemistry, Indian Institute of Science, Bangalore, it is indicated that changes in the fluorescence colour and intensity on the development of rancidity or on adulteration can be detected visually (and not spectrophotometrically). Lines of further study are indicated to develop this technique.

Studies on the manufacture and market quality of ghee

The objects of these studies conducted at the Indian Dairy Research, Institute, Bangalore was to standardise physical and chemical factors arising out of the conditions of manufacture and decide its grain structure and aroma and gather further knowledge on the handling of the raw materials, the technique of manufacture and conditions of packing and storage to improve the market quality of ghee.

As a result of studies so far carried out it is found that pre-stratification, as opposed to direct heating, gives ghee of better initial and better keeeping quality. The ghee clarified at 120°C is better in aroma and keeping quality than ghee clarified at either 110°C or 100°C. The vitamin A content of buffalo ghee decreases on storage at a greater rate than cow ghee and the same applied to the development of rancidity (oxidation). Pre-stratification as compared to direct heating of ghee does not decrease the yield of ghee, decreases the amount of residue and involves lower fuel cost. Refined maize-flour applied in the form of a thin coating on the inner surface of the container together with toplayering the exposed surface (of butter) protects butter from oxiditive spoilage and prevents the spontaneous growth of moulds for 2-3 week. A particular time temperature combination is needed for the development of best flavour and aroma and keeping quality.

A model ghee clarifier of a butter melting capacity of 7.5 lb. has been designed and constructed to work on the principles of pre-stratification process which briefly consists of stratifying the butter after heating it upto 80°C, tapping out the bottom layer of butter milk and then heating the middle layer of ghee and top layer of curd to 120°C till the moisture is reduced to 0.2 per cent.

Scheme on Milk Costing

A scheme for determining the cost of milk production under various conditions was drawn up by an *Ad Hoc* Committee of the Dairy Science Committee and it has been decided that the scheme should be worked in Delhi and surrounding villages.

Animal Nutrition

Indigenous grasses

A scheme is in force since August, 1944 at the Indian

Veterinary Research Institute with the object of determining the nutritive value of certain indigenous grasses at the flowering stage and of certain leafy fodders, at a stage when they are mostly required to be fed to livestock.

During the year, investigations have been conducted on the nutritive value of three species of leaves, (1) *Katchner* (*Bouhenlra variegata*) (2) *Haldu* (*Adina cordifolia*) *and* (3) *Bahera* (*Terminalia belerica*) and four grass mixtures.

Hay mixtures, which grow wild all over the plains and from a substantial percentage of pasture for livestock, were fed to the animals, such animals maintained good health and showed an increase in body weight. In all cases animals recorded positive nitrogen, calcium and phosphorus balance. The mixtures, therefore, compared favourably with most of the commonly used hays.

Haldu leaves (*Adina cordifolia*) in combination with wheat *bhoosa* and rape cake formed a satisfactory maintenance ration for cattle, its digestible crude protein value compared favourably with star-grass-hay and ber leaves.

Behera leaves were found unsuitable to form a maintenance ration for cattle as they resulted in a negative nitrogen, calcium and phosphorus balances.

Katchnar leaves were found to form a satisfactory maintenance ration for goats. Digestible crude protein value of the leaves compared favourably with those of *dub* hay and *pipal* leaves.

The Cattle Feeding Research Scheme U. P., which terminated in 1948 gave very useful results. In this scheme comparative feeding value of barley, maize, *jawar* and *bajra* grain, which are the main cereals of the country were studied on the growing animals of Hariana and Murrah

breeds. Results indicate that in case of Hariana, barley, maize, *jowar* and *bajra* are replaceable, weight for weight, for the same feeding value, though there are indications of the superiority of barley.

However, in the case of Murrah breed *Bajra* and barley are found to be of higher value. Results also indicate that *bajra* can be profitably fed to growing animals wherever available.

Experiments were also conducted to study the comparative feeding values of different straws commonly used in the country. Results, so far as the growth and milk tests are concerned indicate that paddy straw raised in Bharari Farm and its neighbourhood was not inferior to other straws in the locality. On the other hand in certain cases along with *bajra, Karbi,* definitely proved superior to others. Feeding sugarcance tops was found satisfactory, when the amount of oil cake supplement necessary with wheat straw was reduced by 5 per cent. Comparative feeding values of *kharif* and rabi legume fodders were also studied.

In Orissa a scheme was in progress to work out the economics of balanced rations computed from food stuffs available locally. This is being tried for cattle kept under village conditions in reference to (i) milk yield, (ii) capacity for draught and (iii) growth. Feeding experiments will now be conducted in two centres i.e. Udayagiri in the district of Ganjam (Hilly tract and coastal tract) on indigenous cattle of all categories, i. e. young, growing animals, milch cows and working bullocks.

At the Indian Veterinary Research Institute scheme for the extensive use of alkali treated straws for feeding cattle, horses and mules was sanctioned. The object of the scheme was to study, by simple feeding experiments, the

practicability of using extensively alkali treated wheat and paddy straw in the ration of cattle. The feeding experiments were carried out (in the Gowshalas, pinjrapoles and private farms) at the following centres :—

(a)	Montgomery	(now in Pakistan)	wheat straw area
(b)	Rampur	U. P.	do.
(c)	Sodepur	Bengal (Pinjrapole)	rice straw area
(d)	Puri	Orissa (Gowshala)	do.

Feeding trials were carried out both with young stock and milch animals.

Young stock.

The work on young stock was carried out at Sodepur, Puri, Rampur and Montgomery (Pakistan). Two groups were formed (i. e. controlled and experimental) each group consisting of six calves of six to nine months of age. The controlled group animals were fed on untreated straw while the experimental group animals were fed on alkali treated straw. Supplementary feeding stuffs were the same in both the groups. It was seen that the feeding of the alkali treated straw was found to be in general beneficial to the growth of animals. The extent of its effect was, however, not found to be uniform for all centres as the plane of nutrition was different at different centres. The results indicated that there was some relationship between the plane of nutrition and the rate of increase in growth consequent on the feeding of alkali treated straws. The rate of increase appeared to be lower with the improvement in the plan of nutrition.

Milch Animals

The selected animals, which were more or less identical with regard to age, live weight, milk yield, period of lactation, breed and other conditions, were divided into

two groups (viz. (i) control and (ii) experimental). The control group animals were fed with untreated straw as obtained on the form and experimental group animals were fed with alkali treated straw. In case of experimental group it was sub-divided into (a) alkali treated straw and (b) water washed straw groups. The data obtained from the study of the effect of the alkali treated straw and water washed straw on milk productions appears to be of erratic nature for all the centres except Izatnagar. This is mainly due to three fractors, viz. (i) free suckling of calves for priming animals (2) unscientific formulation of rations and (3) lack of control over milk records operating at different centres. The analysis was, therefore, confined to data collected at Izatnagar only. The results of these centres showed that only alkali treated straw had proved beneficial to both the buffaloes and cows. The water washed straw, on the other hand, while proved beneficial to the buffalœs, had actually an adverse effect on the milk yield of the cows. The economics of feeding of these straws indicated that the feeding of the alkali treated straw would give a small marginal profit both for the buffalœs and cows, where as the water washed straw for buffalœs only.

At the Indian Veterinary Research Institute schemes for investigating the causes of degeneration of cattle in humid climate has been sanctioned. The obiect of this is to study the effect of humid climate on Hariana, Sindhi, and Sahiwal cattle and Murrah buffalœs.

A regional centre for Animal Nutrition work is shortly to be opened at the Institute of Agriculture. Anand. The object of this is to regionalise all work on animal nutrition, the central station at Indian Veterinary Research Institute acting in a co-ordinating capacity for the presence.

At the I. V. R. I. a scheme for investigation on the bearing of nutrition on helminthic infestation in animals was sanctioned. The object of this was to find out (1) what would be the dietetic prescription that will allow maintaining of lambs in health and optimum growth, (2) how, by dietetic modification, deficiency symptoms can be developed in lambs for vitamin A, phosphorus, calcium and protein.

Work

Animals were kept on three different protein levels i. e. high, medium and low.

The live weight gain during the 23 weeks of the experimental period for three groups is 11 lb., 10 lb. 8 oz., and 7 lb. 10 oz. respectively. The average body weight of high, medium and low protein group animals was 23 lb. 10 oz., 24 lb. 5 oz. and 21 lb. 3 oz. respectively. The animals were found to consume the required amount of dry matter. The average nitrogen calcium, and phosphorus balances in the three groups were found to be positive.

Animals were examined every month for red blood cell, white blood cell, cell volume, haemoglobin, differential count, calcium, phosphorus and protein. The data will be analysed and presented after the study with these groups is completed.

Animals were dosed with phenothiazine for preventing helminthic infestation. Study on the production of deficiency symptoms in lambs for vitamin A is in progress.

Disease Control

A steady progress was maintained in the Disease Investigation Schemes for cattle, sheep and goats and poultry, working in the various States with grant-in-aids from the Council. The progress report of these schemes

including those which were taken over by the States were scrutinised and their technical programmes coordinated by the Animal Diseases and Pests Committee of the Council. A new Disease Investigation Scheme for Sheep and Goats was sanctioned for the State of U. P. the Council contributing one half of the expenditure for a period of 5 years, while extension for one year was approved for a similar scheme in the Madras State. Although all such schemes for cattle and poultry have now been provincialised, their technical programmes and reports continue to be considered by the expert committee of the Council, in order that better co-ordination may be effected and there is no overlapping of efforts. Regarding the technical programmes of these schemes it has now been decided that since most of the programmes have been standardised, these may only be scrutinised once every three years.

A new pilot scheme was sanctioned for the control of rinderpest by the use of lapinised (rabbit adopted) vaccine to be worked at the I. V. R. I. Similarly a new scheme was sanctioned for extension of T. B. testing in Bihar to find out the incidence of this disease in the wet region of the country. The Council has also sanctioned funds for the preparation of a comprehensive review in the form of a monograph of the Chemotherapy of animal trypanasomiasis with particular reference to Surra.

Diseases of cattle, sheep and goats

Cattle

Rinderpest

As a percussor to the plan of complete eradication of rinderpest from the country by the use of lapinised vaccine the Council's 'Pilot' scheme is to be worked at the I. V. R. I. Under this scheme it is proposed to undertake a large scale vaccination of cattle, buffaloes, sheep and goats

under field conditions and to test the nature and duration of immunity produced by it, and also to conduct other researches connected with the production of vaccine and its use and behaviour in the field.

During the year, this disease was investigated in Madhya Pradesh, West Bengal, Punjab, Ajmer and Kashmir. The viability of different vaccines used was tested and the immunity produced under different conditions was determined. In Madhya Pradesh vaccination by sacrification method gave encouraging results. Immunity tests were however, inconclusive. Viability experiments with dessicated virus gave variable results. In Punjab dried goat tissue vaccine was used on heifers with satisfactory results.

In Ajmer a severe out break in sheep and goats was observed and inoculations with anti-rinderpest serum failed to check the disease. As a result of experiments it was found that the G. T. V. and Special anti-rinderpest serum given simultaneously was the most suitable method for protecting the sheep and goats.

In Kashmir, sheep and goats in the affected area were found to remain free from the disease. In the Kashmir Province the G. T .V. was found to keep potent for a fortnight when packed in wooden cases and saw dust, while under same storage conditions it kept viable for 10 days, in the Jammu Province. When packed in ice in thermos-flask it kept viable for over a month in Kashmir Province.

Foot and Mouth Disease

The scheme for devising a suitable method of vaccination for the control of foot and mouth disease continued at the I. V. R. I and during the year under report nine viable strains were received from the field and typed. This has brought the number of Indian field strains tested so far from various parts of the country to 61 of which 19 are

found of Vallee 'o', 16 'o', Varient, 5 Vallee 'A', 13 'A' varient, 2 Waldmann 'C' 5 'C' varient and one a typical. These observations clearly indicate that 'O' type is predominant in India also.

Crystal Violet Vaccine (for Foot and Mouth Disease). Two brews of bi-valent ('O' and 'C') and one brew of monovalent ('O' blood) vaccine reinforced with tongue epithelium were prepared. Both these vaccines were used in 15-45 cc dose, depending upon age, on 88 dairy animals without producing any untoward effects. Immunity conferred by the crystal violet vaccine, tested so far, was found to be solid upto 11 months.

As a result of foot and mouth disease a reduction of 53.0, 15.7 and 32.2 per cent in the milk yield was found to occur in cross bred, Afghan. and Hill breeds of cattle respectively at the Mukteswar Dairy.

The variation in the yield is probably due to the difference in the degree of susceptibility. The foot and mouth disease virus is found to be executed through milk 24-72 hours before the onset of clinical symptoms.

Contagious abortion (*Brucellosis*)

This disease was investigated in Bombay, Baroda, Punjab, Madhya Pradesh and Orissa.

In Bombay a survey of the Arey milk colony where a large number of urban milch animals have now been moved was done to find out incidence of abortions. As a result of tube test and Quick Agglutination test 10-12 per cent animals gave positive reaction. In Nasik two bulls suffering from Orchitis and Synovitis were found positive on test. Testing of animals was also done on infected farms where out of 184 serum samples 57 were positive to the test; out of 472 animals 64 were positive in Quick Agglutination test. Calfhood vaccination gave good results

as none of the heifers vaccinated in 1947-48 aborted or calved prematurely. Vaccination of adult (negative) empty animals in infected farms was done with satisfactory results. On farms where testing and vaccination is practised the incidence of abortions is much less year after year.

In Baroda out of 68 Kankrej cows, and 45 Surti buffaloes only one was found positive on test. However, on one of the farms, 3 cases of abortions occurred among cows which had been vaccinated only a few months back. In Punjab out of 419 animals on a farm 109 were found positive and 4 gave doubtful reaction. Among this 13 heifers, some of which had not yet been served also reacted positively to the test.

In Madhya Pradesh a survey of the disease was undertaken mainly at Government Cattle Breeding Farms and dairies and in rural cattle breeding centres and out of 1448 animals of all classes that were tested 178 proved positive and 23 gave a doubtful reaction. Calfhood vaccination and vaccination of adult animals was done in village cattle breeding centres and farms with encouraging results. In a farm in Orissa, the incidence of Brucellosis has been considerably reduced by repeated testing and segregation.

Tuberculosis

The Council's scheme for a survey of tuberculosis and Johne's diseases continued to function at the I. V. R. I. Under this scheme about 3,255 doses of concentrated synthetic tuberculin were prepared for use in field. Milk samples from 74 reactor cows and buffaloes were subjected to biological test and results were expected later. Out of six specimen received from suspected cases of Tuberculosis from domestic animals 2 from rabbit were found positive and were apparently of the bovine type.

Tuberculine test of animals was under-taken under the scheme and the incidence of the disease was as follows :-

	Place	No. of animals tested	No. of positive	No. of suspicious reactors.
1.	Military Dairy (Cattle)	220	35*	
	Dehra Doon; I.V.R.I. (Buffaloe)	406	78*	
	Scheme			
2.	I. V. R. I. (Cattle)	158	1	
3.	Karnal Farm (Bullock)	64	39	
4.	Bombay.	242	11	
5.	Baroda	739	62	10
6.	Madhya Pradesh	147	XX	8
7.	Kashmir.	160	8	3

* Infection was higher in adult animal than the youngstock.

In Kashmir the incidence was found to be higher in stall-fed animals (10.5 per cent) than in the village cattle (4.5 per cent) thus corroborating the previous year's findings.

Johne's Disease

During the year 1,450 doses of Johnin were prepared at I. V. R. I. and sheep and goats were tested against Johne's disease by intradermal method using Johnin. Out of 112 sheep and 286 goats 3 sheep and 12 goats reacted positively. While 21 sheep and 20 goats gave a doubtful reaction. Out of 104 animals tested at Karnal farm 14.4 per cent were positive. 158 animals of the dairy herd at Muktesar tested with Johnin proved no infection amongst them. 385 faecal samples were also examined by smear examination of which 31 showed acid fast bacilli indistinguishable from *Mycobacterium tuberculosis.*

In Bombay 63 animals were tested with Johnin with negative result.

Surra

This was encountered and investigated in the States of Bombay, Ajmer-Merwara and Orissa.

In Ajmer-Merwara chemical analysis of urine of Surra affected camels showed it to be highly alkaline and contained demonstrateable quantity of sugar. In the Bombay State Surra was confirmed in buffaloes, cows, sheep, horses and dogs, and in all cases T. *evansi* was detected on microscopic examination. In the course of investigation of an undiagnosed disease out of 33 cows 21 were surprisingly found positive to Surra, on Complement Fixation test. The disease was reported to be endemic in Orissa and generally prevalent during August to September. Eleven cases were confirmed microscopically although Formal-gel and Mercuric chloride tests on positive animals gave variable results. Treatment with Antrypole in all cases gave good results.

Horn cancer

In the State of Baroda investigations on this problem were further pursued with a view to determine the factors associated with causation of the disease. Deficiency of calcium or phosphorous was not observed in the blood of affected animals. Nasal discharge and horn tumours were found to be free from any type of bacteria or parasites. Histopathological examination, however, revealed that the growth is a squamous celled carcinoma. It is reported that generally a period of 3-12 months elapses between injury and the appearance of cancer. Both the horns are rarely affected.

Urinary Lithiasis

Various aspects of this problem were studied in the

Baroda State. Incidence is reported to be higher in certain districts. Seven cases were recorded in bullocks. Fodder analysis from the affected locality revealed richness of phosphates and excess of salts. Similar results were observed on analysis of soil and water from the affected locality.

Clinical Nutritional Survey
(Deficiency Diseases)

A clinical survey and investigation on the incidence of conditions caused by nutritional deficiencies was made in the States of Punjab and Madhya Pradesh. In Punjab on a clinical survey of six districts no evidence of the absence of trace elements was encountered in animals. In the Kangra valley a weed called Autava Camerelin was suspected to be poisonous but on feeding experiments and chemical analysis this was not confirmed. In Simla and Kangra District no clinical case of iodine deficiency was either observed in cattle although human beings in the locality suffered from goitre. In Madhya Pradesh a rheumatic condition in working buffaloes in the summer months leading to progressive emaciation and partially subsiding after rains, was found to be due to high flourine content of ' Tiwra ' seeds and bhoosa which are fed to animals in the affected area. The flourine content of these is found to reduce by 50 per cent after rains and the incidence of the disease also goes down.

Nasal Schistsomiasis

This condition is reported to be common in Chhattisgrah and Rajpur divisions of Madhya Pradesh. The disease is reported to be at its peak during winter months and show partial subsidence on the onset of summer with again secondary rise in rains. On examination comparatively few Schistosomia nasalis, eggs were detected in the nasal discharge from clinically affected cases during summer

than in rains. Snails in the affected areas revealed infection with forked tail apharyngent ceraris without pigmented eye spots. Treatment of the affected animals with anthiomative infections gave very good results.

Disease Caused by Anaerobes

The scheme for the investigations of diseases of animals caused by anærobes continued to function at the Indian Veterinary Research Institute. The anærobes from material received were isolated by cultural and biological means and biochemical studies were taken up to determine species of these organisms. A study of the normal anærobic the type flora occuring in the ailmentary canal of sheep has been undertaken with a view to determine the different species of anærobes, particularly the different types of *Cl* : *Welchii* that these animals may harbour.

Sheep and Goats

A further survey of the common contagious diseases of sheep and goats has been carried out this year by various Assistant Disease Investigation Officers, (Sheep and Goats) in their respective States, and statistics regarding the incidence, symptoms, and mortality of various diseases was recorded with the merging of Baroda State with Bombay, the Scheme of Assistant Disease Investigation Officer (Sheep and Goats) for Baroda was terminated this year.

Entero-toxaemia

This disease was further investigated in the State of Baroda. Good results were obtained on vaccination of animals with Entero-toxaemia vaccine (B X W), during and after the out-break of this disease. Mortality in vaccinated and non vaccinated was 2-3 per cent and 10-15 per cent respectively. Intravenous infections of anti-serum gave variable results.

Sheep and Goat pox

The disease was investigated in several states. In Mysore hyper-immunised and *non by pcrimninised* sera were prepared and on biological tests the two sera were not found to differ in their power of sensitisation of a known potent sheep-pox virus. Sheep vaccinated last year were found to remain immune in the face of an outbreak. Goat pox virus was successfully transmitted to sheep. Etherisation was found to immunise bacterial contamination in the pox-pulp. Goat pox vaccine was prepared in Mysore and used with satisfactory results, in the face of an outbreak. In Bombay sheep - pox was encountered on a very wide scale in the southern districts of the State and 8,803 sheep and 206 goats were vaccinated with encouraging results. Immunity produced by vaccination of 3 occasions was found to last for not more than 9 months.

Contagious Caprine Pleuro-Pneumonia

In Bombay three type of vaccines, viz. attenuated culture vaccine, fresh crude lymph vaccine and Longley's Carbolised vaccine were tried and best results were obtained by the use of culture vaccine. Crude lymph vaccination gave very severe reaction contrary to previous year's observations. Local type of goats were found to be equally susceptible to infection. Outbreaks of the disease were common in October-November in the Baroda State. As a curative N. A. B. gave very good results. Formalised lung vaccine did not give satisfactory results but fairly good results were obtained by the use of live virus lung emulsion. In Mysore however, the field results of vaccination with formalised emulsion of lung lesion were generally good.

Rickettsiosis in Sheep

This disease has been recorded for the first time in a

merino ram in Bombay State. Rickettsial bodies were identified as *Rickettria Ovina.* Ticks collected from the body of the ram were found to be the carriers of the infection. The course of the disease was 2 weeks. Soluseptacine treatment gave good results. Experimentally the disease was transmitted to guivea pigs.

Poultry Diseases

Ranikhet Disease

This disease like previous year, was the most common and fatal disease of the poultry and caused heavy economic losses. In most of the States it occured throughout the year. In Bombay, the disease occured in all the districts. Mortality was generally 85-95 per cent but in three subacute out-breaks it was only 60%. Both the Organotropic (abdominal) and Neurotropic forms of the disease were noticed. In majority of cases newly purchased birds were the main source of introducing the infection. In Punjab, the incidence is reported to be declining. In Madhya Pradesh, out-breaks occured both in fowls and turkeys. Except for chicks below one week which proved resistent, birds of all ages and breeds were equally susceptible. In Mysore, the disease was confirmed on biological tests. In Baroda, the disease was observed both in acute and chronic forms, and was more prevalent in summer.

In all the States, vaccination of clean birds against this disease was undertaken with satisfactory results. Mass inoculation centres which were started in West Bengal last year continued to work and 23 such centres operated during the year. A very large number of birds were vaccinated in various States under the poultry disease investigation Schemes. In majority of cases, a satisfactory immunity developed after mild reaction. In some cases, the reaction was, however, severe. In Bombay as a result of post vaccina-

tion reaction 50 per cent birds had partial and temporary blindness, 10 per cent had paralysis of legs and egg yield of the layers was reduced for 2-3 weeks. Immunity following vaccination was found to be solved for 12 months in vaccinated birds in Bombay and West Bengal. In Punjab 3 per cent birds suffered temporary lameness and 0.9 per cent died after vaccination. In Baroda a temporary reduction in egg yield was observed but it returned to normal in3-4 weeks, and a mortality of 4 per cent amongst the vaccinated was observed. Experiments to find out the earliest age at which birds could be safely and effectively vaccinated against Ranikhet disease were undertaken in many States. In Punjab it was found that chicks below 6 weeks of age could be safely vaccinated. In Bombay results of vaccination in 2-5 weeks old chicks were variable. Experiments in Madhya Pradesh showed that minimum effective age for vaccination is 14 days.

Fowl-Pox

This disease occured in various forms in different States. In Bombay its incidence was higher at Farms but lower in villages 30-70 per cent mortality was observed in 2-4 weeks, old chicks. Chicks vaccinated below the age of 6 weeks did not acquire satisfactory immunity, but in older animals immunity upto 6 months was conferred. In Punjab the disease occured in many districts during spring and autumn. Like Bombay, mortality among chicks was higher. The disease occured mostly at the organised farms in West Bengal. Large number of birds were vaccinated safely. In Madhya Pradesh adult birds had cutaneous form of this disease, while chicks had catarrhal and diptheritic fevers. Vaccination with mixed Fowl-pox vaccine from I. V. R. I. gave encouraging results, both as prophylactic and Curative in Madhya Pradesh and West Bengal. In Baroda the disease was found to be more common in hatching season and in summer. In Mysore, preparation of, and field trials with fowl-pox and pigeon pox

vaccines were under-taken. Pigeon pox virus was being used extensively for protecting birds against fowl-pox. The vaccine was used without any adverse effects among chicks of all ages, including day old chicks as well as laying hens, without setting up any constitutional disturbances in the former or effecting egg yield in the layers. However, the immunity set up was of a shorter duration.

Fowl-Cholera.

Practically no outbreak of this disease could be confirmed in any States except West Bengal during the year under report. In West Bengal two out breakes were confirmed biologically. Blood examination showed organisms identical with *Pasteurella avicida.* Attempt to transmit the disease however, failed.

Tuberculosis.

Testing of birds with tuberculosis was further undertaken by the various A. D. I. O. in States. Out of 570 fowls tested in Bombay 21 reacted positively. On a second test 7 however, proved negative. In Punjab all the 464 birds tested proved negative. Generalised T. B. was seen in a fowl on post-mortem in West Bengal. Two birds that reacted positively to the test showed nodular lesions in the ovary and intestines. In Madhya Pradesh no lesions were found on post mortem in 1296 cases.

Spirochaetosis.

This disease, has been reported from the states of Punjab, Baroda, Hyderabad and Madhya Pradesh. In Punjab the disease begins in summer and continues till December. Birds of all ages and breeds are effected but heavy breeds and chicks suffer most sulfarseual gave good results as a curative. The disease was responsible for heavy losses of Poultry in Madhya Pradesh where it was common from March to

November. Desi fowls are reported to be some what resistent. In Hyderabad on comparative treatment between Sulfarseol and Soamin, the former was found to be superior Gammaxene was used with good results as a tick vector in Baroda while in Punjab ½ per cent. Derris dressing removed the ticks, 40 per cent mortality was recorded in Baroda where the disease was confirmed microscopically.

Coccidiosis

This is another common disease which affects the poultry adversely and occured in most of the States and was responsible for heavy mortality. It was more common in Farms in West Bengal though poultry in the villages was also affected. *Eimeriatenella* was found to be responsible for it in Bombay and West Bengal. In the latter State Sulphaguanidine in 3 per cent mash was found to give good results while Sulphaphyrazine failed. In Bombay Sulphamerzattine and Soluthiazole was tried with appreciable success. 2-12 weeks old chicks were found to be affected in Madhya Pradesh and in these both the intestinal and *ceacal* forms were present. Feacal examination showed immature oocysts of *Eimeria tenella* and *Eimeria mitis.* It was interesting to observe that the chickens kept under natural conditions remained free from the disease. Feeding the oocyrt experimentally produced the disease in 7 days. As curative Sulphamezathine and Sulphamerazine gave very good results. 16 per cent solution of the former also acted as good preventive in Hyderabad.

Helminthiasis

Helminthiasis infection of poultry was encountered in most of the States and common poultry worm were detected on feacal and post-mortem examination. In Madhya Pradesh, Phenothiazine and Cestrasol were found effective in affected birds. Latter drug was found superior to collodial Iodine Proper sanitary and hygienic measures were found to check

the infestation in Hyderabad. Use of oil of chenopodium and oil of turpentine given over a period of 2-3 months resulted in saving about 60.75 per cent of the affected chicks. In Punjab on faecal examination incidence was found to be comparatively higher in Kangra, Simla and Sub-mountaineous areas of Gurdaspur and Kalka. Normal worm burden was studied and showed Typeworms 5-8 per cent Ascaridia 5.5 per cent and Heterkis 20-25 per cent.

Avian Leucosis Complex

In Mysore this disease was encountered in all poultry Farms where improved breeds of poultry are maintained. All the different types of the disease were observed on post-mortem of birds that died of the disease. Histopathological and cytological examinations were undertaken.

Contagious Coryza

This occured in Mysore and its clinical manifestations were studied. Morphological studies of the pathogenic organisms, by using cooled Rubbit Blood Media were made. Thiazamide was found to be effective in treatment.

Trichomoniasis

This disease was recorded in West Bengal and Hyderabad 80 per cent mortality occured in the two outbreaks in West Bengal. *Trichomonad flagellate* was seen on postmortem which had invaded caccum, upper intestinal tract and liver. Treatment with Phenothiazine proved ineffective Carbazone 1 per cent dissolved in 1 per cent Soda Bicarb in-drinking water gave good results. The disease was detected among pigeon, in Hyderabad and the casual organism was found to be *Trichomonad Columbac Refer.*

Salmonellosis

This disease caused heavy losses amongst 0-12 days

old chicks during the winter months. In Bombay salmonella organisms A, B, C, D and E were isolated from heart blood cultures and yolk sac. All the five organisms isolated were found to be highly pathogenic. Due to the presence of this disease all the laying stock on the farm was tested with Salniowella antigen but none have showed positive reaction. It also occured in Ducks in West Bengal and was partially controlled by the adoption of hygienic measures.

Ectoparasites

Ectoporasites (Lice, ticks and mites) were noticed in poultry in almost all the states. In Bombay Gammaxene smoke generators were found to be effective. Gammaxene was also found effective in several other States.

Avitaminosis 'A'

In Madhya pradesh young chickens from one to four months of age specially those confined to limited area were found to be usually victims of this deficiency disease during Summer months. Material from chickens died of this disease showed no traces of vitamin 'A'. Lack of non-woody greens was found to be the main reason for this trouble. Cod liver oil was found ineffective but a mash containing 2 per cent dry clover meal was found effective in preventing the development of symptoms.

Co-ordinated Schemes On Helminthiasis

The Livestock helminthic infestation schemes continued to function at the I. V. R. I. Veterinary Colleges, Madras and Calcutta and in the Lucknow University. The scheme at the I. V. R. I. was extended for a period of 3 years and the one at Veterinary College Madras for a period for one year.

Under the scheme at I. V. R. I. histopathological

changes occuring in liver in advanced and chronic infections due to *Dicrocoelium dendriticum* were studied. Further experiments were conducted to test the efficacy of the daily administration of small doses of 0.25 per cent and 0.5 per cent Copper sulphate solution in combating amphistomiasis in ruminants. Results were encouraging. Life history of *Monezia expansa* was further studied. The difficulty of keeping the transmitting units alive was overcome by collecting mites a few months earlier than in the previous year, and these remained alive for a longer period. The mites were found to be very susceptible to moisture and dryness and after several trials it was found that they survived best in jars containing natural soil, grass and moss. The artificially infected mites were found to harbour all stages of the worm, and fully developed infective cyrticercoids were recovered from them after 18 weeks.

Life history of *Parafilara bovicola* was also studied. It is found that the worm punctures the skin of the host for the purpose of discharge of eggs. Bursting of the nodule takes place during the hot hours of the day. A study of the intermediate host of blood fluke *Sehistosma indicum* was made. *Indoplanorbis exustus* snail were found to be commonly infected with infective cucaria. From a study of the eggs of *Ascaris Vitulorum*, it was found that their full development took place in 5-6 days. Petroleum either in a total dose of 0.3 C. C. per kilo-grams live body weight given in three daily doses gave good results.

In the scheme at Madras attempts to artificially infect calves by feeding infective eggs and active larvæ of A vitulorum failed to produce the adult parasite. In a couple of cases to produce the adult parasite, existence of pre-natal infection of calves with Ascaris, Vitulorum was confirmed. One calf was found to pass eggs 26 days after birth. Studies on the life history of *Paramphistomum*

cervi and *G. Crumenifer* were continued. Eight cultures of *Paramphistomum* eggs and six of *Gastrothylax* eggs were produced and viable miracida obtained. In connection with the study of the life history of Monezia Sp. observations already made regarding an ovibated mite acting as vector were confirmed. A relationship was found to exist between the mite and the soil, humidity and rains. It is observed that the soil should neither have too hard a texture as clay nor too loose as sandy loam of black cotton. It was confirmed that Monezia benedeni also has the same species of mite for its transmission. The mite involved have been studied in detail and is recognised on a new species and designated as *Scheloribates madraserisis*. Another oribated mite of species of *Galumna* is also found to act as a vector. Some more work in the binomics of snail *Limnaea* and Indo-planorbis was done. Limnæ type of snail has been found to have no definite breeding season as it lays eggs throughout the year. Eradication of weeds and other plants associated with snails in tanks gave good results. A groove in the concentration of 1=5,00,000 and 1,10,00,000 gave good results under limited conditions, to destroy the snail host.

In the scheme at Lucknow life histories of *M. expansa*, Avitellivea centripunctata. *Stilesiaglobipunctata* and *Trichocephalus* ovis were studied. Four parasites were studied. Attempts to reproduce the infestation with M. Expansa by feeding its cysticercoids to kids did not materialise. *Tricocephatus ovis* was artifically transmitted to rabits and guinia pigs by feeding its embryonated eggs. In West Bengal Musea and Stomonys type of flies were found to be the possible vectors in the transmission of hump sore. The parasite, stephano-Filaria assamensis was recovered in the gut of the flies that had been fed in hump sore cases. On investigation Fascioliasis was found to be common in 24-

Parganas District Hexachloroethane as a treatment gave good results. Good results are also reported when calves affected with *Haemonchous contortus* and *Ascaris Vitulorum* were given 8 c. c. Tetrachlorethylene in flour paste followed by Dihydroxyanthis quinone (Dispensible powders).

A scheme for investigating the helminthic parasites affecting poultry in India commenced functioning at the I. V. R. I. The object of this scheme is to investigate factors controlling the resistence of the poultry to its two commonest helminthic parasites and also to study the viability of their eggs with a view to finding out suitable measure of control. It has been found that chickens of 14 weeks or more in age develop a very high resistence against *A. galli* and *H. galli ae.* In regard to the viability study of eggs, among various media tried for culture experiments the best results were obtained with distilled water to which a few drops of 0.1 per cent formation were added. It was observed that embryomic development of egg does not take place at temperature below 12°C though the eggs remain viable for a long time. The optimum tempt. is 30°-32°C at which infective stage is reached in 5 days. Embroyonated egg are found to remain viable for a long time after having reached the infective stage. Detailed study of the life history of Fowl tapeworms *Raillentia Cesticillus* and *Choanotaenia infundibulum* has been made. Beetles have been found to act as natural intermediate hosts.

Investigations on the control of different parasites of cattle, sheep and goats were also carried out in the various States. In Orissa and Bombay the Ascar infection of young calves was found to be common, and for its control in Orissa periodic administration of tetrachlorethylene emulsion followed by Dignone gave good results. The survey of Fascioliasis was continued in the Kashmir State. In highly infested calves Hexachlorethane was found to give satisfactory results. Similarly

in Madhya Pradesh this drug was found to be safe. However, as a result of use of this drug a marked reduction in milk yield in the period immediately following dosing was observed. The yield, however, returned to normal within a week's time. Among other control measures spraying of fields with 1:5,00,000 solution of copper sulphate was found to be very effective. After a systemetic survey incidence of *Dicrocaelium dendriticum* in sheep was found to be 20 per cent in Jammu Province and 30 per cent in Kashmir. In a survey in the Bombay State 80 per cent sheep are found to harbour *Oesophagostomum Columbianum* and due to this, sheep are reported to die in rainy season, i.e. July to October and February to May Phenothiazine was found effective against these. Amphistomiasis was also found to be common in Bombay State, was successfully controlled by the administration of Tetrachlorethylene.

Use of indigenous drugs in veterinary practice.

The scheme for the investigation of indigenous drugs with special reference to this toxic principles and devising suitable antidotes continued to function in the State of Madras. During this year two new plants were taken for study while work on several plants already under investigation was completed. *Plumaria acuminuta* after feeding experiments, was found to be non-toxic and contained no useful principles. Two plants Sorghum *helepense* and *Saecharum spontaneum* were found to have hydrocynic acid in them in amount that would prove poisonous to animals. Detailed work was however, done in the *Calotropis gigantica* and the pharmacological action of madar juice were carried out. It was found that the various parts of the plants viz the leaves, flowers and barks are non-toxic to cattle in doses that will prove fatal to cermines. Its active principle in physiological doses slows the heart but augments the beat.

In Madras, also the scheme for collecting and collating information on indigenous drugs used in veterinary practice from ancient literature and Sanskrit manuscript continued to function. A number of ancient books have been consulted from important libraries in India and a large number of prescriptions on the treatment of cattle ailments and selected portions of literature pertaining to diseases were translated. This scheme has been extended upto 31st March, 1952.

As a counterpart of this, a scheme for collecting useful prescriptions of indigenous medicines actually used by village practitioner as well as in the veterinary Hospitals in Northern Indian was initiated at the headquarters during this year and a retired Veterinary officer with previous experience of similar work was put incharge. So far about 300 useful prescriptions have been collected, under this scheme which has been since extended for a period of one year.

Hides and Skins

With a view to establish a correlation between the regional occurrence of various common species of cattle ticks in India and the extent of damage caused by them to the hides and skins geographical distribution of important ticks was investigated and areas with heavy and medium infestation were tabulated. It was observed that extreme of temperature, i. e., below 45°F and above 102°F, is a natural limiting factor in the development and multiplication of cattle ticks. On the other hand mild heat accompanied with humidity is more favourable to tick multiplication than the mild cold and humidity. Dry condition whether created in cattle shed, or securing natural conditions is found to be a definite limiting factor in tick multiplication. A number of tickicidal drugs were tried. Gamatox paste on 2.08 per cent strength was found to kill the unengorged

ticks in 24 hours with 100 per cent mortality. Nymphs and partially engorged ticks were found to be gradually killed by it in 72 hours. However, engorged ticks remained unaffected and oviposed normally. The drug was found to have a residual effect upto 6 days. Because of its inaction on engorged ticks it is not considered economical for large scale use. *Mosquitox* an indigenous proprietory insecticide was found to kill tick *Boophihs microphs* in all stages in short time. However, a number of ticks remained all attached to the body of the animal. A serious drawback was, however, observed. The drug caused a certain amount of burning and scurfing of the skin among the treated animals and the duration of its residual effect was not more than 48 hours, which was an economic set back in application of the drug on a field scale. Feeding trials with Gammexane as Acavicidal drug were made with promising results.

The scheme for control of ox warble fly pest had been first started in the Punjab and then transfered to the Uttar Pradesh. The work done had shown that the infestation of warble fly was reduced from 57 per cent to 23 per cent when better preventive and curative methods were taken in hand. It was noted that singeing was good far destroying the eggs on the legs of cattle. A smouldering torch had been devised for the purpose.

Bee-Keeping

(i) Two Regional Bee Research Stations under the Council, one at Katrain (Punjab) and the other at Coimbatore (Madras) have been sanctioned, with a view to carry out fundamental research on (a) the habits and culture of Indian Honey Bees, (b) honey and wax and (c) to standardise management parctices for profitable bee keeping.

(ii) During the year work on the development by selection of high yielding and less swarming strains of *pisindica* was undertaken at the All India Bee Research Station, Katrain (Kulu). Experiments conducted on migratory system of bee keeping gave encouraging results. Honey gathering capacity of the bees in a colony recorded more than proportional increase with the increase in the number of the bees in colony. It was found that in order to obtain stronger colonies for the honey flows, cessation of the bee activity should be avoided during April and July by restoring to artificial feeding. Role of Honey bee *A Indica* in the pollination of various fruits and seed crops was studied and the percentage of bees as compared to other insects was studied, and found to be of the required standard.

Fish and Fisheries

Under the Rural Piscicultural Scheme Madras, food habit and habitat of 14 species of fish found in Madras waters have been studied. In the case of some species observations have also been recorded on the breeding habits and rate of growth. Experiments on acclimatisation and transport of fish have been carried out a number of species, which are however of a preliminary nature and have, in most cases, been performed without any control of factor or factors responsible for mortality during the process of acclimatisation or of transport of fingerlings.

Investigations have also been carried out to account for the mortality of fish in certain tanks and remedial measures suggested in this connection. The experiments carried out so far on manuring and feeding experiments indicate that organic fertilisers were more effective in producing algal bloom and yielded better growth of stocked fish than inorganic manure like ammonium phosphate. The effect of inorganic manure can be best produced by utilising a combination of more than one salt.

A large number of useful observations have been recorded in regard to the hydrobiological conditions of a number of waters in Madras State. Some of these observations are of importance from the point of view of fish culture.

Under the Fisheries, Scholarship sponsored by the Council final reports of the following three schemes which were allotted to research workers at the Calcutta University have been received.

(1) Production of food in fishery ponds suitable for major carps and seasonal variation of food of carps.

(2) Ecology of *Mughil parsia* in the salt water *bheries.*

(3) Life history and bionomics of *Mughil parsia* etc, in different stages.

The work in these schemes appears to have been carried out satisfactorily.

A scheme on Piscicultural Research at the Annamalais University has been sanctioned for a period of 3 years from 1-4-1951. The object of the scheme is (1) the determination of the commencement, seak and termination of the breeding activity (2) the factors that might be involved in the onset and termination of annual sex cycle and the (3) the recurrence of the reproductive cycle in the life of the fishes found near the University area.

CHAPTER IV—DELHI DEVELOPMENT SCHEME

General

This is the third year of the Scheme. Some of the improved seeds, implements and practices which were introduced have established their reputation without any doubt. As for instance, all the irrigated wheat is under P.h 591 and 518.90 per cent of *jowar* area is under improved Malwa variety. The use of iron ploughs is steadily increasing every year.

The main activities of the Scheme are described below :—

Distribution of improved seed

Distribution of following quantity of improved seeds was done in order to increase per acre yield of crops.

1.	Wheat	1100 md.
2.	Gram	3600 ,,
3.	Maize	800 ,,
4.	*Jowar* Seed (Malwa)	2000 ,,
5.	Potatoes	20 ,,
6.	Sugarcane	1351 ,,
7.	Vegetable Seeds	1066 lb.

Introduction of new crops.

(a) Moong Type 1, a kharif legume which matures in 60 days, was introduced as an experimental measures during the year under report. This has proved useful in eliminating the kharif fallows before wheat. It is expected that within three years, most of the *kharif* fallows may be under this crop.

(b) *Gram T-87.* This type of gram was imported from Uttar Pradesh and sown for the first time and it succeeded well. It has a bolder grain and its yield per acre is about 10 per cent higher than the local variety.

Improved implements

Shabash plough from Allahabad Agriculture Institute is still leading in popularity but other types from M/S. Cooper Engineering Co., Satara, M/S Kirloskar Brother & M/S Cossul & Co., Kanpur are also being tried.

Ploughs purchased upto March, 1951	Ploughs sold upto March, 1951
1031	828

In addition to the ploughs, four new implements i. e. a Five Disc McCormick Seed Drill. Five Tyne Cultivator, a Bullock Power and Bullock Power Thresher were tried during this year. The thresher and seed drill have become very popular because of saving in labour.

Manure

In addition to Farm-yard manure, the use of the Ammonium Sulphate for top dressing wheat, Sugar-cane and vegetable crops was demonstrated in all the villages and it is gaining popularity. We were able to dispose off 83 mds.-29 seers of ammonium sulphate and the cultivators themselves purchased about 200 truck-loads of Badli dump town refuse.

Horticulture

2467 fruit plants and about the same number of fuel plants were planted in the current year. A nursery for raising vegetable seeds and fruit plants was also started at Bowana.

Fisheries :

Fish from five tanks of Scheme villages were auctioned fot Rs. 1900. This extra income has removed the prejudice of local cultivators against the rearing of fish. All the tanks have been restocked.

Poultry

11 cockrels and 70 hens of exotic breeds were sold to the cultivators. The cross-bred chickens are fetching higher prices than pure local ones ; hence the keeping of exotic birds is getting popular though slowly because of caste prejudice.

Piggery

Of the three Yorkshire boars supplied last year, two died during the year. The remaining boar has given very good service and the result can be seen in the village Bawana where large number of cross-bred pigs are seen. The cross-breds fetch about 25 per cent higher prices than local ones of the same age.

Cattle improvements

In order to improve cattle of the area, a Key Village Scheme along with an Artifical Insemination Centre was started early in 1951. The first item of the programme of work under the Key Village Scheme, namely a preliminary house survey for ascertaining the number and distribution of cattle in the area and for finding out feed resources etc. has been completed. Arrangements for replacing the unapproved bulls in the area by approved bulls, for castration of the former, for the milk recording of a random sample of the cow population etc., are now in hand. It is proposed that breeding work should be done as far as possible by artificial insemination with semen of high class bulls main-

tained at the Artificial. Insemination Centre, located in the Veterinary Hospital, Bowana. The staff of this centre has been given the necessary training, the buildings and equipment have been provided and a small beginning has been made in the artificial insemination of few cows in Bowana. This side of the work is being developed in the light of experience, the ultimate aim being to have natural insemination replaced as far as possible by artificial insemination.

Cooperative milk production and marketing scheme

A scheme for organised production and marketing of milk on cooperative lines in the ten villages of the Delhi Development Scheme in order to ensure the maximum benefit to the producers as well as to ensure the supply of pure and good quality milk to Delhi was sanctioned in September, 1950, at a total cost of Rs. 90,000/-. The scheme envisages the setting up of cooperative milk producing societies in the ten villages, provision of milk sheds with hand pumps and water troughs for centralised milking, collection, transport and distribution of milk and supply of concentrates to member-producers at wholesale prices. The ultimate target of milk production is 50 mds. per day, fifty per cent of the profits accruing from the sale of milk in Delhi shall be distributed amongst the member-producers in the form of milch animals. equipment etc., which may be required by them and the remaining 50 per cent shall be utilised for purposes of reserve and developmental work.

Milk collection under the centralised milking system was started on the 31st January, 1951, in certain villages covered by the Delhi Development Scheme. In the system of centralised milking, the member-producers bring their cattle to a central milking place and milking is done in the presence of the mukhaddams employed under the Delhi Development Scheme.

As milking is done at 7 A.M. and 6 P.M. it is necessary to distribute the morning production in the evening and the evening production the following morning. In order to enhance keeping quality of milk and prevent sourage losses it is necessary to process the milk on receipt in Delhi and coldstore it until required for distribution. Arrangements for pasteurisation and cold storage of milk have been made at a private dairy (Messrs Edward Keventer (S) Ltd).

Milk is sold to the public through the Sale Depots opened under the scheme in various localities of Delhi.

CHAPTER V-AGRICULTURAL AND ANIMAL HUSBANDRY RESEARCH

Fodders And Grasses

Scheme for the improvement of pasture grasses and legumes (I.C.A.R.)

A model Scheme for the improvement of pasture grasses and legumes drafted by the Indian Council of Agricultural Research, the details of which were given in the last year's report was circulated to all the States in Schedules "A" and "B" and they were asked to submit schemes on the lines indicated in the Model Scheme with such modifications as might be necessary according to the local conditions. Schemes from the Governments of U. P., Punjab, Bihar and Bombay have been received. The first three States have requested the Council to meet the full cost of the scheme whereas the Government of Bombay have agreed to share the cost on 50:50 basis. These schemes will be considered by the Research Board of the Council at the next meeting.

Other Crops

Schemes for the introduction of milk yielding trees, Bombay

One hundred and sixty five seeds of *Brosimum Galactodendron* variety of milk yielding trees were received from our Trade Commissioner at Trinidad (Venezuela). These have been distributed for trials to the following :-

1. Government of West Bengal-Calcutta.
2. Director of Agriculture, Madras.
3. Government of U. P. Lucknow.
4. Horticulturist, Bombay Govt., Poona.
5. Director, Dairy Research Institute, Bangalore.
6. Inspector General of Forests, New Delhi.

Co-ordination Of Research

In order to enable the Indian Council of Agricultural Research to carry out fully its responsibility for promoting and coordinating agricultural and animal husbandry research in India, the Governing Body of the Council desired that in future the annual technical reports and programmes of work relating to agriculture and animal husbandry activities of the State Governments, Research Institutions under the Union Government including Research Stations under the Central Commodity Committees, should be furnished to the Council for consideration by its Scientific Committees the idea being to enable the Council to make suggestions to the various States, Institutions and Commodity Committees for more effective colloboration between scientific workers and thus to avoid duplication and waste of effort. It was further decided that a meeting of Directors of various Commodity Committees would also be arranged immediately after the meetings of the Scientific Committees to give them an opportunity to review the results achieved at different stations and discuss items of common interest with a view to coordinate the research programmes.

During the year under review, various Scientific Committees of the Council considered reports and programmes of work received from the State Governments Central Institutes, and Central Commodity Research Stations, for 1949-50 and 1950-51, respectively, at their meetings held in November, 1950. Their remarks were duly communicated to all concerned after these were approved by the Directors' Conference. A meeting of the Directors of State Departments of Agriculture and Animal Husbandry, Directors of Commodity Research Stations of the Central Commodity Committees, and Central Institutes was held in January, 1951 to review the results achieved at different stations and discuss items of common interest with a view to coordinate the research programmes.

CHAPTER VI—STATISTICAL RESEARCH

Advisory Work

The Statistical Branch of the Council continued its advisory work relating to the design of agricultural and animal husbandry experiments and the interpretation of their results, examination of technical programmes and annual reports of the Council's schemes and the scrutiny of statistical papers received for publications in the Council's Journals. A number of Statistical enquires received from the Food and Agricultural Organisation of the United Nations, Central Government, State Governments and other institutions were also dealt with.

Training

Twenty students were admitted to the Certificate Course and seven to the Diploma Course in Agricultural Statistics during the year 1950-51. Eleven students were deputed by the State Governments of Madras, Punjab, Bihar, Hyderabad Cutch, Indian Central Cocount Committee and Indian Institute of Sugar Technology, for training in the Applicational Course.

Nine regular students and three members of the technical staff of the Council passed the Certificate Course Examination held in July, 1950. One Diploma student submitted his thesis, which has been approved by the examiner.

Three students of the Applicational Course (1949-50) were examined on the completion of the Course in May, 1950, and all of them were declared successful. Eleven students of 1950-51 course were examined after the completion of the First Term in December, 1950, and all were declared successful. Seven of them are now continuing in

the second term of the course which will finish on the 31st May, 1951.

The students of all the three courses were taken, as usual, to the I. A. R. I. to study the problems in practical agriculture in various Divisions of the Institute. Special training in field work relating to crop-cutting experiments and area sampling was given to the students for over a fortnight in the villages under the Delhi Development Scheme of the I. C. A. R. The students of the Diploma Course were taken to the Institute of Plant Industry, Indore, where they studied the problems in genetics and field experimentation as in the previous year. They also paid a visit to the I. D. R. I., Bangalore and Livestock Research Station, Hosur, to study the animal husbandry problems. The students of the Applicational Course were taken on instructional tour to the Agriculture Institute, Allahabad, and Sugarcane Research Station, Shahjahanpur. The students of the Certificate Course were deputed for a fortnight to the Directorate of Economics and Statistics, Ministry of Agriculture for the first hand training in dealing with official agricultural statistics.

Research

Crop-cutting surveys

During the year under report sample surveys for estimation of yield of crops have been extended to all principal food crops in all the Part 'A' States, some of the Part 'B' States, viz, Hyderabad, PEPSU and Mysore and part 'C' States of Delhi, Ajmer and Coorg through the implementation of the five-year coordinated scheme of crop-cutting experiments sanctioned by the Government of India. The scheme is expected to be extended to most of the remaining States from the kharif season of 1951-52. Similar scheme for estimating the yield of groundnut, gingelly and castor in Madras, linseed in M. P. and rapeseed and mustard in U. P. prepared

by the Council, were sanctioned by the I. O. C. and have been initiated on a pilot scale in M. P. and Madras. A pilot survey for estimating the yield of jute was also carried out in one district of Orissa during 1950-51, at the instance of the I.C.J.C. The Government of India have given a further grant to extend the scope of the scheme in order to cover the States of Bihar, Orissa and Assam and it will be taken up during the kharif season of 1951-52.

The schemes for estimating the yield of cotton and sugercane, which were formulated at the instance of the respective Commodity Committees are expected to be implemented during the next year.

Sample surveys for estimation of area underprincipal crops

In addition to crop-cutting surveys for yield estimation of a survey for estimating the area under crops has been initiated in Orissa under the technical direction of the Council during the kharif season of 1950. Normally no sample survey is necessary for this purpose as statistics of crop area are compiled by the method of complete field to field enumeration which as a method is perfect in principle. Orissa too was hitherto compiling its area statistics by the same method with the help of a special field agency but disbanded this organisation owing to financial stringency. In replacement of the method of complete enumeration the State Government have now adopted a plan of sampling evolved by the Council which is expected to furnish reliable estimates of acreage for districts in case of principal crops and for the State as a whole in respect of others.

Assessment of results on G. M. F. C.—Sample surveys for assessing the results of activities under G. M. F. C. have been continued by the Council on the G. M. F. measures

of improved seed and manures on a more extended scale in the States of Bombay and M. P. and have been initiated in Madras too on a State-wide scale. Surveys for the assessment of result from construction of minor irrigational projects were started in Assam in Kharif and Bihar in the Rabi. Similar surveys have also been carried out in the Rabi season in M. P. and Madhya Bharat for assessing the additional production from land reclaimed by tractor ploughing under the C. T. O.'s plan.

The progress of the surveys was reviewed by the ad hoc Committee at its meetings held in May, 1950 at Indore and in February, 1951 at Poona. The results obtained so far have indicated that while in respect of improved seed the official yard-sticks were correctly placed, those in respect of manures appeared to be somewhat exaggerated. The Committees recommended that the scope and coverage of the assessment surveys needed to be extended during 1951-52 since the surveys have been found to furnish very valuable information on the extent to which the targets of additional food production are being realised. The Committee further recommended that in view of the major role of irrigational projects in reaching our food targets, it is essential to check up by means of a sample survey on an all-India scale, how far targets of the construction of irrigational works have been actually achieved in practice and to estimate the acreage really irrigated therefrom and requested the S. A., I. C. A. R. to initiate the survey during the current year itself in cooperation with the respective States. The survey is proposed to be taken up in 1951-52.

Marine Fishery Statistics. The exploratory survey in the Malabar Coast for estimating the total catch of fish, a reference to which was made in the previous report of the Council has just concluded. After studying the

practicability of different designs of sampling, a multi-stage plan with landing centres as primary units combined with systematic sampling in time at the selected centres was finally adopted. The plan is expected to provide the basis of estimating the number of boats landed and the average catch per boat. The preliminary analysis of the data is now in progress.

Livestock statistics. An exploratory survey with the main object of developing a suitable method of sampling for improving the livestock statistics have just been completed in one district of U. P. About 15 per cent of the villages were selected at random from each tehsil of the district (the total number sampled being 210) and complete house to house enumeration of livestock was carried out in these villages. Model sampling schemes are proposed to be tried on the basic data so obtained with a view to formulating a suitable sampling method for estimating these numbers. An attempt is also being made to investigate the possibility of estimating production of milk by enquiries.

A sample check on patwari's records in U. P. A pilot investigation was conducted in Lucknow district for ascertaining the accuracy of acreage statistics maintained by patwari staff by means of supervision on a random sampling basis through an independent agency comprising of the statistical staff at the State. The enquiry has revealed that although the *patwari* records in respect of individual fields are not free from errors and do offer scope for correction and improvement, the picture of land utilisation as revealed from the totals of acreage compiled or large administrative units, such as a district, a division or a state is broadly correct, at least in respect of major crops. The names of crops were generally correctly recorded by the patwaris and the discrepancies arose principally from an incorrect allocation of area between various constituent crops grown on the same

survey number which is somewhat inevitable in any method of eye appraisement of areas. Some discrepancies were also ascribeable to the rules prevailing in the land records constraining the patwaris to record acreage of mixed crops in a certain manner. A threepronged remedy appears to be called for, viz, limiting patwari's jurisdiction in order to enable him to attend to his duties more carefully, modifying rules for recording areas in respect of mixtures and tightening the work of supervisions over patwari's work and rationalising its basis in order to render it more effective. In respect of the first two remedies, recommendations have already been made by the statistical Committees of the I.C.A.R. whereas exercising supervision over patwari's work on a rationalised basis by an independent agency has been provided for as a principal features in the five-year coordinated scheme for the estimation of yield of principal crops sanctioned by the Govt. of India.

Improvement of agricultural statistics. An integrated five year plan for effecting an overall improvement in the agricultural statistics of India was prepared by the S. A. to the Council and passed on to the Planning Commission for consideration.

Analysis of the data of the Punjab sheep Breeding Scheme

The analysis of the data on the face colour inheritance of Bikaneri sheep collected under the Council's sheep breeding scheme at Hissar, was completed, and the results of analysis are under study. There is, at present, a prejudice against breeding white faced Bikaneri sheep because they are supposed to bear a weak constitution. The object of the present study was to find out how far this was justified.

Statistical analysis of the vanaspati data

A detailed statistical analysis of the data collected under

the Council's Vanaspati Research Scheme at I.V.R.I. has been taken in hand.

Ad-hoc Wool Sampling Committee

A meeting of the ad hoc Wool Sampling Committee was held at Poona in March, 1951 with a view to defining a rule of procedure for drawing final samples from a prepared lot of commercial wool.

Assessment of the incidence of diseases and Pests on major crops

It was proposed at a meeting of Entomologists, Mycologists and Statisticians that a survey for assessment of the incidence of diseases and pests on major crops should be linked up with the sample surveys for the estimation of average yields of crops. The details for the initiation of the survey are being worked out.

Crop-cutting experiments in the villages of the Delhi Development Scheme

A sample survey for assessing the results of the activities of the Development Scheme, in so far as increasing the average yield per acre of crops is concerned, was carried out in the Delhi Development villages. The survey covered both wheat and gram during the current rabi season. In addition information was also collected relating to agro-economic problems in general. The analysis of the data collected is in progress.

The Governing Body of the Council at its meeting held in February, 1951 sanctioned two schemes, viz.

(i) Statistical analysis of the data collected in the breeding schemes at the I.D.R.I., Bangalore, and Livestock Research Station Hosur, and

(ii) Statistical analysis of data collected in the sheep breeding schemes at Hissar and Mysore.

The Council has also agreed to give a grant to the I.C.C.C. for a pilot scheme for estimating the requirements of labour and materials for the production of cotton and rotation crops in Madhya Pradesh. The object of the scheme is to provide a scientific basis to plan future enquires into cost of production. These schemes will be implemental during 1951-52.

Theoretical research

A number of technical papers were prepared by the staff of the Council during 1950-51. Some of the important papers are given below:-

(1) Measurement of the basis in sample surveys (preliminary report) by Drs. Sukhatme and Seth.

(2) Further contributions to the theory of probability distribution of points on a line-Part II. By Dr. Krishna Iyer.

(3) Some remarks on Cramer-Rao, lower bound to the variance of unbiased estimates by Dr. Seth.

(4) An exact method for analysis when more than one plot are missing, by Dr. Seth.

(5) One sampling without replacement with varying probabilities by Dr. R. D. Narain.

(6) A note on Mathisen's and Dixon's for two samples by Mr. D. R. Kohli.

A bulletion of sample surveys giving a popular and consolidated account of the crop-cutting surveys so far carried out under the direction of the Council was also published during the year under report.

CHAPTER VII

Library

The I. C. A. R. Library is an up-to-date research Library for the use of the Officers of the Council and others engaged in research work on agriculture and allied sciences in the country.

The Library has a very valuable collection of books, periodicals, pamphlets and annual reports, and English translations of special articles in German, French, Russian and other languages. The total stock has been estimated to be about 70,000. The total number of the different kinds of journals at the library is about 870 of which about 140 are subscribed, about 350 are being received free or on exchange basis and the remaining ones have either stopped publication or have been discontinued. The library also receives a large number of technical pamphlets, bulletins, circulars, etc. on exchange basis from Agricultural and Veterinary Research Institutes and Government Departments all over the world.

At present the major bulk of the library stock is housed in the Linlithgow Library Building at the I. A. R. I. New Delhi with a sectional library at Jamnagar House, consisting of a selection of useful latest books, periodicals, bulletins and reports for the immediate use of the officers of the I.C.A. R. who are located there.

The total number of books and other publications added during the year is 663. The number is exclusive of reports and pamphlets less than 100 pages and current issues of periodicals. The number of publications issued on loan is about 6,000 and the number of current issues circulated through the sectional library is about 2,700. A large number

of books and publications were also consulted at the libraries at Pusa and also Jamnagar House. As in the previous year there was a greater demand on books in the Statistics section of the library.

A thorough reorganisation of the library has been taken up. The following items of work with periodicals have just been completed.

(1) Compiling an alphabetic list of all the periodicals (2) Countrywise list of all the periodicals (3) Classified list of the periodicals according to subject (4) Alphabetic list of periodicals for display. The holding of our library under each title is being scrutinised and will be worked out accurately in the card catalogue. The catalogue cabinet is being organised on modern lines of progress made in this direction. Typed lists of monthly additions are circulated to officers and are also filed for ready consultation at Pusa and Jamnagar House Libraries. Cuttings from English newspapers, all over India of references to I.C.A. R. and their activities as also important press comments on agriculture and allied subjects are carefully collected and circulated to the officers of the Council and these are always available for ready reference.

APPENDIX

APPEN

Annual Account of Income and Expenditure of the Indian

RECEIPTS.

Head of Account	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
	Rs.	Rs.	Rs.
I. Opening Balance	4,20,523-2-2*		
II. Receipts under A.P. Cess Act	36,62,586-0-0	28,000	29,870
Deduct amount transferred to reserve fund	1,83,500-0-0	9,000	7,900
	34,79,086-0-0	24,000	7,400
III. *Contribution of Grants*			
(a) From Indian States			
(1) Mysore		1,000	1,300
(2) Baroda			
(3) Kashmir	5,000-0-0	3,000	1,470
(5) Co-chin			
(6) Bikaner	20,000-0-0		
(7) Bhopal	2,500-0-0	..	5,450
(8) Jaipur	20,000-0-0		
(9) United States of Sauarastra & Rajkot	20,000-0-0		
	67,500-0-0		
(b) From Central Government			
(1) For Crop-cutting experiments			

* This does not include a sum of Rs. 1468/1/6 standing in the Reserve Fund Account.

DIX

Council of Agricultural Research for the year 1950-51.

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs.	Rs.	
A—STANDING CHARGES			
Accounts & Audit	29,863 1 0	+ 6 15 0(*a*)	(*a*) Inconsiderable.
Travelling allowance of non-official members of the Council	7,850 12 0	+49 4 0(*a*)	
Tavelling allowance of members of the Committees of A. B. and of other persons invited to attend the meetings	7,406 0 0	— 6 0 0(*a*)	
T. A. of non-official members of the Board of Agriculture and A. H. in India	1,296 6 0	+ 3 10 0(*a*)	
Miscellaneous	1,464 15 0	+ 5 1 0(*a*)	
B—RESEARCH TRAINING AND PUBLICITY UNDER DIRECT CONTROL OF I. C. A. R.			
(*i*) *Agriculture*			
Indian Institute of Fruit Technology	4,789 2 6	+660 13 6(*b*)	(*b*) Saving due to non-payment of above bills.
(i) Description of different varieties of fruits (ii) Abstraction of horticultural literature	21,470 7 6	+429 8 6(*b*)	

RECEIPTS.

Head of Account	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
	Rs.	Rs.	Rs.
(2) For co-ordinated wheat rust scheme.			30
(3) For I. I. F. T.			
(4) For the scheme using arrial photography			
(5) For Jute crop-cutting experiments	6,000-0-0		
(6) Crop-cutting experiments, U.P. and Madras.	21,116-5-4		
	27,116-5-4		
IV. Interest from investments			
(1) 2¾% loan 1962	26,059-8-0	...	
(2) 3% loan 1963-65	49,361-4-0	...	
(3) 3% 2nd victory loan 1959-61	14,962 8- 0	...	
(4) 3% victory loan 1957	55,546-12-0	5,590	21,900
(5) Fixed deposits etc.	31,799-14-0	...	
	1,77,729-14-0	...	
V. Miscellaneous receipts			
(1) Receipts realised from schemes	1,50,074-1-1	...	
(2) Receipts on account of unspent balance of grants made by the Council	24,654- 1-7	...	
(3) Miscellaneous	36,245- 8-6	20,000	...
	2,10,973-11-2	...	...
		...	2,250
VI. Debts and Remittances.			
(1) Loans and Remittances repayable	2,333-5-0	8,000	...
(2) Deposit and advances repayable	37,483-10-7	56,000	...

PAYMENTS

Head of Account	Expenditure during the year.	Excess (—) or saving (+) over net grant,	Remarks.
5	6	7	8
(i) *Agriculture (contd.)*	Rs.	Rs.	
Drug Plants	...	+ 30 0 0	(*a*) Adjust-
Green Manuring Survey	338 8 0	—1338 8 0	(*c*) ment of
Appointment of a Fibre Expert	...	...	expendiiure
Hand Book of statistics on Plant Breeding & Agricultural Problems by Dr. F.J.F. Shah	2,250 0 0	...	
(*ii*) *Animal Husbandry*			
Characteristics of grey breeds	...	...	
Utilization of kitchen swill as food for livestock	...	...	
Pilot Key village scheme	13,046 7 0	—276 7 0	(*a*) (*a*) Inconsi- derable.
Monograph on "Maintenanace of farm animals in Health"	...	...	
Manual on "Preparation of animals for Indian market"	...	...	
Manual on "Breeding of farm animals in India"	...	...	
Monograph on "Veterinary Entomology"	1,269 0 0	— 29 0 0	(*a*)
Monograph on "Statistical methods in A. H."	...	...	
Inheritence of quantitative characteristics and laying qualities of egg	...	...	

RECEIPTS			
Head of Account.	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
	Rs.	Rs.	Rs.
(3) Recoveries from staff on account of income tax provident fund etc.	2,807-14-0	23,000	12,770
	42,624-13-7		
Total Receipts and opening balance	44,25,553-14-3		
Investment and re-investment on fixed deposits	16,15,000-0-0	1,000	...
		700	...
Amount transferred to Reserve Fund	1,83,500-0-0	2,900	...
Grand Total	62,24,053-14-3		1,240
		500	...
		200	...
		10,000	...
		50,000	1,28,680
		18,430	13,880
		28,110	43,480
		2,430	3,820
		...	1,510
		...	1,430
		1,60,000	2,12,000
		500	360
		...	...
		...	14,640
		...	8,490

PAYMENTS			
Head of Account	Expenditure during the year.	Excess (—) or saving (+) over net grant,	Remarks.
5	6	7	8
(ii) *Animal Husbandry (contd.)*	Rs.	Rs.	
Camel Breeding I. C. A. R.	...	...	
Miscellaneous			
Crop cutting experiments on wheat and paddy	1,27,253 10 0	+1426 6 0(*b*)	(*a*) Saving due to non-payment of bills.
Library	13,923 11 3	— 43 11 3(*a*)	
Editorial staff for Indian Farming	43,435 6 9	+ 44 9 3(*a*)	
Duplicating Section	3,574 12 0	+245 4 0(*a*)	
Crop-cutting experiments (Jute)	1,506 1 0	+ 3 15 0(*a*)	
Co-ordination of research	1,426 9 0	+ 3 7 0(*a*)	
Village projects, Delhi	1,94,304 11 0	+17,695 5 0(*a*)	(*a*) Inconsiderable
Publication of abstracts	349 10 0	+ (*b*)	
	...	10 6 0(*a*)	(*b*) Some bills were paid last year.
Collection of marine fishery statistics	14,630 3 0	+ 9 13 0	
Improvement of livestock statistics	8,475 15 0	+ 14 1 0(*a*)	

RECEIPTS			
Head of Account.	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
	Rs.	Rs.	Rs.
		...	11,100
		14,100	9,500
		4,550	5,120
		...	8,560
		...	8,630
		...	...
		7,300	8,380
		8,000	9,190
		...	20,700
		...	160
		3,850	2,630
		...	4,800
		...	540
		...	7,630
		6,050	7,000
		...	...
		—	8,370
		5,280	6,090
		7,600	...
		16,400	16,500
		10,880	14,540
		1,62,000	42,370

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	7
	Rs.	Rs.	
C—GRANTS-IN-AID			(a) Inconsiderable
(i) AGRICULTURE			
(a) *Rice*			
Rice breeding Bombay	11,101 14 0	— 1 14 0	0(a)
Rice breeding Punjab	9,500 0 0	...	
Rice breeding Coorg	5,126 0 0	— 8 0	0(a)
Rice breeding Hyderabad	8,558 10 0	+ 1 0	0(a)
Rice breeding Kashmir	8,626 0 0	+ 4 0	0(a)
Rice diseases, Madras	8,378 10 0	+ 1 6	0 a)
—do— W. Bengal	9,190 0 0	...	(a)
Inset pest of paddy W. Bengal	20,709 0 0	— 9 0	0(a)
Monograph on rice breeding and genetics	160 0 0	...	
Boro Paddy, W. Bengal	2,630 0 0	...	
Manurial experiments on paddy lands, W. Bengal	4,800 0 0	...	(a) Inconsiderable
(b) *Wheat and other Cereals*			
Breeding rust resistant wheat, I. A. R. I.	541 7 6	— 1 7	6(a)
Wheat breeding Madhya Pradesh	7,630 0 0	...	
Wheat rust research Bombay	7,000 0 0	...	
Wheat rust scheme S. India	8 0 0	— 8 0	0(a)
Maize breeding Punjab	8,362 13 9	+ 7 2	3(a)
—Do— U. P.	6,090 0 0	...	
—Do— Bihar	...	...	
—Do— W. Bengal	16,500 0 0	...	
—Do— I. A. R. I.	14,000 0 0	—540 0	0(a)
Co-ordinated wheat rust control scheme (Mycology) Simla.	42,914 10 0	—544 10	0(a)

RECEIPTS

Head of Account	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		10,250	11,900
		650	4,110
		9,300	12,140
		8,000	7,260
		...	50
		5,000	
			4,250
		...	3,900
		7,000	4,240
		3,500	2,000
		4,200	8,600
		...	830
		...	1,600
		1,300	980
		1,400	16,140
		4,900	...
		9,000	8,150
		10,000	4,560
		15,000	8,440

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs.	Rs.	
(b) *Wheat and other Cereals*			
-Do- Delhi			
-Do- Agra			
Coordinate wheat rust control scheme (Botany), Delhi			
-Do- Pusa			
-Do- Simla			
-Do- (M.B.) Indore			
(b) *Millets and Pulses*			
Pulse breeding, Madras	11,897 6 6	+ 2 9	7(*a*)
Do— Bombay	4,108 10 5	+ 1 5	7(*a*)
Do— U. P.	12,136 0 0	+ 4 0	0(*a*)
Do— W. Bengal	7,860 0 0	...	
Do— Bihar	45 0 0	+ 5 0	0(*a*)
Do— Orissa	4,252 5 0	— 2 5	0(*a*)
Do— Assam	3,900 0 0	...	
Do— Hyderabad	4,238 0 0	+ 2 0	0(*a*)
Do— Mysore	2,000 0 0	...	
Do— Madhya Bharat (Gwalior)	8,600 0 0	...	
Do— (Bombay) Baroda	826 0 0	+ 4 0	0(*a*)
Do— U. P.	1,600 0 0	...	
Do— Mysore	980 0 0	...	
Do— Gram wilt disease Punjab	11,144 4 0	— 4 4	0
Soya beans, Punjab	—	...	
Striga attack on Sorghum, Madras	8,150 0 0	...	
Hybrid Cumbu, Madras	4,560 0 0	...	
Insect pests of stored cereal grains Punjab	8,440 0 0	...	
Striga attach on Jowar, Bombay	40 9 8	—40 9	8(*a*)

RECEIPTS

Head of Account	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		...	160
		...	70
		...	2,550
		...	2,620
		27,160	350
		14,140	37,510
		18,000	14,880
		11,000	14,000
		770	7,860
		15,160	46,580
		14,140	13,320
		2,240	4,470
		4,670	3,290
		1,830	...
		...	1,000
		8,350	16,000
		16,230	13,800
		5,030	10
		9,000	10,970
		8,160	8,100
		900	1,170
		...	230
		...	1,490
		8,500	6,360
		1,610	...
		3,400	3,450
		2,900	1,530

PAYMENTS

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs	Rs.	
(d) Oilseeds			
Caster breeding Hyderabad	156 4 3	+ 3 11	9(*a*)
Pests and diseases of linseed, M. P.	72 0 0	+ 2 0	0(*a*)
Pests of Saffower, Bombay	2,553 0 0	— 3 0	0(*a*)
Groundnut, breeding Mysore	2,617 0 0	+ 3 0	0(*a*)
(e) Fruits			
Horticulture, Madras	347 0 0	+ 3 0	0(*a*)
Do— Bihar	37,510 0 0	...	
Do— M. P.	14,875 0 0	+ 5 0	0(*a*)
Do— Assam	14,000 0 0	...	
Do— Orissa	7,860 0 0	...	
Do— Hyderabad	46,582 1 4	— 2 1	4(*a*)
Do— Mysore	13,320 0 0	...	
Do— Kashmir	4,473 0 0	— 3 0	0
Orange cultivation, Coorg	3,290 0 0	...	
Mango necrosis, Lucknow	...	...	
San Jose Scale Survey	997 0 0	+ 3 0	0(*a*)
Cytogenetics of Mango and banana, Poona	16,003 2 0	— 3 2	0(*a*)
Banana research, Madras	13,797 7 0	+ 2 9	0(*a*)
Do— Bombay	6 0 0	+ 4 0	0(*a*)
Do— W. Bengal	10,970 0 0	...	
Do— Calcutta Uty.	8,100 0 0	...	
Yield data from fruit orchards, M. P.	1,172 0 0	— 2 0	0(*a*)
Citrus manurial trials, Punjab	229 0 0	+ 1 0	0(*a*)
Citrus Physiology, Bihar	1,492 0 0	— 2 0	0(*a*)
Insect Pests of fruits U. P.	6,362 0 0	— 2 0	0(*a*)
Bud Selection Societies Bihar	...	...	
Orange diseases, Madras	3,446 0 0	+ 4 0	0(*a*)
Research on Orange, Madras	1,530 0 0	...	

(*a*) Inconsiderable.

RECEIPTS

Head of Account.	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		5,910	9,960
		4,690	4,190
		5,640	3,680
		4,320	3,020
		3,420	...
		5,910	...
		4,250	2,860
		4,400	2,700
		6,780	...
		7,470	12,610
		11,990	8,770
		13,000	4,700
		2,870	2,300
		7,410	4,310
		5,100	230
		...	900
		...	2,300
		8,020	...
		...	19,800
		13,260	13,920
		7,190	...
		5,400	...

PAYMENTS

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs.	Rs.	
(f) Vegetables			
Tuber crops, Bombay	9,590 0 0	+370 0 0	(a)
Do— Punjab	4,190 0 0	...	
Do— Bihar	4,052 0 0	—372 0 0	(a)
Do— Orissa	3,020 0 0	...	
Do— Mysore	...	...	
Do— U. P.	...	...	(a) Inconsi-
Do— Madras	2,860 0 0	...	derable.
Research on tomotoes, potatoes and other vegetables, Bananas only	2,700 0 0	...	
(g) Other crops			
Turmeric, Bombay			
Do— Orissa	12,609 0 0	+ 1 0 0	(a)
Cardamoms, Madras	8,770 8 0	— 0 8 0	(a)
Pepper, Madras	4,700 0 0	...	
Ginger, Madras	2,300 0 0	...	
Chillies, Madras	4,312 0 0	— 2 0 0	(a)
Palmyra, Madras	227 0 0	+ 3 0 0	(a)
Cloves, Travancore	900 0 0	...	
Coriander diseases, Madhya Bharat (Gwalior)	2,300 0 0	...	
(h) Soils and Manures			
Sewage farming, Bangalore	...	...	
Control of erosion, Visva Bharti Institute	19,770 0 0	+30 0 0	(a)
Trace elements in Indian soils, I. A. R. I.	13,923 13 9	— 3 13 9	(a)
Soil erosion, Rajasthan (Jaipur)	...	...	
Soil improvement in spent up orchards, U. P.	...	...	

RECEIPTS			
Head of Account.	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		7,000	...
		700	4,910
		...	140
		6,170	7,900
		...	1,900
		...	1,140
		24,500	34,840
		...	8,470
		16,000	7,200
		660	4,590
		3,630	7,390
		...	2,540
		22,340	...
		...	3,050
		...	80

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
(*h*) *Soils and Manures (Contd.)*	Rs.	Rs.	
Soil analysis, Andhra Uty.	...	...	
Crop production by Catalysis Bangalore	4,909 14 6	+ 0 1 6(*a*)	
Composting of manure	144 0 0	— 4 0 0(*a*)	
Nitrogen fixation in soils, I. A. R. I.	7,867 14 0	+32 2 0(*a*)	
Phosphetic manuring, I.A.R.I.	1,900 0 0	...	
(*i*) *Agronomy*			
Crop-weather co-ordination Poona	1,132 0 0	+ 8 0 0(*a*)	
(*j*) *Physiology*			
Plant Physiology, Mr. Boshi Sen	34,864 4 6	— 24 4 6(*a*)	
(*k*) *Entomology*			
Schools of research	8,466 0 0	+ 4 0 0(*a*)	(*a*) Inconsiderable
Research on insecticides, Punjab	7,200 0 0	...	
Test with D.D.T. 666-I.A.R.I.	4,590 0 0		
—do— Bombay	7,380 0 0	+10 0 0(*a*)	
—do— U. P.	2,540 0 0	...	
(*l*) *Mycology*			
Virus diseases, Bombay	...	...	
Schools of Research	3,054 0 0	— 4 0 0(*a*)	
Fungicidial sprays, I.A.R.I. & Mysore	77 10 0	+ 2 6 0(*a*)	

RECEIPTS.

Head of Account	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		1,620	15,120
		4,840	1,070
		12,190	...
		25,470	24,600
		30,000	...
			1,580
			410
			2,420
		29,560	...
		2,510	...
		...	...
		...	7,490
		7,580	4,130
		10,860	...
		4,660	550
		2,640	2,640
		24,990	16,990
		12,360	10,910
		9,170	...
		17,000	15,030
		6,060	10,000

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs.	Rs.	
(m) *General*			
Introduction of new economic plants, I. A. R. I.	15,124 0 0	— 4 0 0(*a*)	
Crop seeds, Delhi Uty.	1,000 0 0	+70 0 0(*a*)	
(ii) ANIMAL HUSBANDRY			
(*a*) *Cattle Breeding*			
Livestock investigation, Punjab	...	...	(*a*) Inconsiderable
Cattle improvement and insurance, PEPSU	24,600 0 0	...	
Causes of degeneration of Indian Cattle, I. V. R. I.	...	...	
Cattle improvement, Bombay	1,570 9 0	+ 9 7 0(*a*)	
—do— U. P.	406 0 0	+ 4 0 0(*a*)	
—do— Ajmer Merwara	2,409 0 0	+11 0 0(*a*)	
—do— Bombay (Baroda)	...	...	
—do— Travancore-Cochin	...	...	
Preparation of Monograph on the Anatomy of ox	53 0 0	—53 0 0(*a*)	
(*b*) *Goat and Sheep Breeding*			
Goat Breeding, Punjab	7,488 6 3	+ 1 9 9(*a*)	
Goat Breeding, Orissa	4,132 0 0	— 2 0 0	
—do— Cochin			
Angora goat breeding, Punjab	554 0 0	— 4 0 0(*a*)	
Sheep breeding, Madras	2,589 4 6	+50 11 6(*a*)	
—do— Bombay	16,987 0 0	+ 3 0 0(*a*)	
—do— Punjab	10,909 1 0	+ 0 15 0(*a*)	
—do— Orissa	...	...	
—do— Kashmir	15,030 0 0	...	
Angora Goat, U. P.	10,000 0 0	...	

RECEIPTS.

Head of Account	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		...	200
		15,600	...
		1,000	...
		...	150
			20
			200
			...
			...
			...
		5,000	...
			60
			...
			2,050
			...
			3,130
			4,560
		5,150	...
		5,240	2,500
		...	4,680
		...	4,460
		...	3,260
		...	5,640
			3,190
		5,200	...
			3,870
			...

PAYMENTS

Head of Account	Expenditure during the year.	Excess (—) or saving (+) over net grant,	Remarks.
5	6	7	8
(b) *Goat and Sheep Breeding (Contd.)*	Rs.	Rs.	
Scheme for the trial of improved farm breed Bikaneri, Punjab	196 10 0	+ 3 6 0(*a*)	
(c) *Animal Nutrition*			
Animal Nutrition, Madras	...	...	
Nutritive value of leafy fodders, I. V. R. I.	...	...	
Influence of trace-element on the health and productive capacity of livestock, I.V.R.I,	151 0 0	— 1 0 0(*a*)	
(d) *Animal Pests and Diseases and Cure*			
Veterinary Investigation Officer (Cattle) Madras	18 0 0	+ 2 0 0(*a*)	(*a*) Inconsiderable
-do- Bombay	198 0 0	+ 2 0 0(*a*)	
-do- U. P.	...	...	
-do- Bihar	...	...	
-do- C. P.	...	...	
-do- Assam	...	...	
-do- Orissa	100 0 0	—40 0 0(*a*)	
-do- W. Bengal	...	...	
-do- Punjab	2,046 0 0	+ 4 0 0(*a*)	
-do- Hyderabad	...	...	
-do- Ajmer Merwara	3,133 1 0	— 3 1 0(*a*)	
-do- Kashmir	4,560 0 0	...	
-do- Bombay (Baroda)	...	...	
-do- Mysore	2,500 0 0	...	
V.I.O. (Sheep & Goats) Bombay	4,675 0 0	+ 5 0 0(*a*)	
-do- Madras	4,462 0 0	— 2 0 0(*a*)	
-do- Punjab	3,266 0 0	— 6 0 0(*a*)	
-do- Bihar	5,638 2 0	+ 1 14 0(*a*)	
V. I. O. Orissa	3,193 0 0	— 3 0 0(*a*)	
-do- Kashmir	...	...	
-do- Mysore	3,870 0 0	...	
-do- Bombay (Baroda)	...	...	

RECEIPTS

Head of Account.	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		...	29,780
		15,400	...
		...	15,190
		...	21,430
		6,650	5,080
		11,640	13,950
		3,260	10,420
		...	18,500
		6,300	8,350
		12,300	...
		...	8,100
		35,000	...
		30,040	...
		3,730	...
		3,730	...
		3,450	...
		2,520	1,880
		...	230
		...	14,850

PAYMENTS

Head of Account	Expenditure during the year.	Excess (—) or saving (+) over net grant,	Remarks.
5	6	7	8
(*d*) *Animal pests and diseases and cure (contd.)*	Rs.	Rs.	
Tuberculosis and John's diseases among animals I. V. R. I.	29,780 0 0	...	
Helminth parasites I.V.R.I.	...	...	
Vaccination against foot and mouth diseases I. V. R. I.	15,188 1 0	+ 1 15 0(*a*)	
Damage caused by ticks and warble flies, I. V. R. I.	21,432 4 0	— 2 4 0(*a*)	
Helminthiasis of Cattle, Madras	5,080 0 0	...	
-do- U. P.	13,945 0 0	+ 5 0 0(*a*)	
Diseases caused by anaerobes, I. V. R. I.	10,420 0 0	...	
Tuberculin testing, Madras	18,495 0 0	+ 5 0 0	
Indigenous Drug used in Veterinary Practices	8,351 14 6	— 1 14 6(*a*)	(*a*) Inconsiderable
Bearing of nutrition on helminthic infection, I. V. R. I.	...	...	
Indigenous drug used in Veterinary medicines, Madras	8,100 0 0	...	
Control of bovine pleuropneumonia, Assam	...	...	
Investigation of mastitis, I. V. R. I.	...	...	
-do- Bombay	...	...	
-do- W. Bengal	...	...	
-do- Punjab	...	...	
-do- Mysore	1,880 0 0	...	
(*e*) *Dairying*			
Development of ghee industry, M. P.	221 0 0	+ 9 0 0(*a*)	
Nutritive value of vanaspati I. V. R. I.	14,848 7 0	+ 1 9 0(*a*)	

RECEIPTS			
Head of Account.	Receipt during the year.	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		2,550	2,630
		13,950	...
		13,990	7,560
		12,180	7,520
		7,720	3,550
		6,000	7,000
		17,800	16,270
		17,470	19,560
		17,470	...
		17,470	10,000
		17,460	4,000
		18,630	...
		32,600	3,180
		...	3,550
		24,080	22,700
		2,110	...
		...	360
		...	2,500
		...	...
		500	...

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
(*e*) *Dairying (contd)*	Rs.	Rs.	
Quality improvement in milk and milk products, Allahabad	2,630 13 0	— 0 13 0(*a*)	
Rapid determination of fats, etc. of milk, U. P.	...	...	
Rapid deterimination of fats, etc. of milk, W. Bengal	7,560 0 0	...	
-do- Punjab	7,520 0 0	...	
Standardising methods for the analysis of ghee, I.D.R.I.	3,553 0 0	— 3 0 0(*a*)	
Bacteriology quality of market milk, W. Bengal	7,150 0 0	—150 0 0(*a*)	
Standardisation of the technique of manufacture to improve the market quality of ghee	16,270 0 0	...	
Analysis of Milk, I. D. R. I.	19,560 0 0	...	
-do- Bombay	...	...	
-do- U. P.	10,000 0 0	...	
-do- Bihar	4,000 0 0	...	
-do- Institute of Hygiene and public Health	...	...	
Heat resistant flora in India milk I. D. R. I.	3,180 0 0	...	
Ghee analysis, I. I. Sc., Bangalore	3,310 0 0	+240 0 0(*a*)	(*a*) Inconsiderable
(*f*) *Wool*			
Wool analysis, Bombay Uty.	22,635 6 0	+64 10 0(*a*)	
Wool analysis, Bihar	...	...	
(*h*) *Poultry*			
Poultry breeding, I. V. R. I.	355 0 0	+ 5 0 0(*a*)	(*b*) Demand funds recd. late.
-do- Bombay	4,190 0 0	—1,690 0 0	
-do- Punjab	0 3 0	— 0 3 0(*a*)	
-do- Madhya Pardesh	14,634 0 0	—14,634 0 0(*b*)	

RECEIPTS

Head of Account.	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		...	640
		3,000	...
		1,000	2,160
		...	450
		1,720	460
		4,000	...
		...	18,410
		2,700	5,400
		...	...
		...	4,860
		6,830	4,030
			...
			...
		16,170	290
		1,000	...
		...	100

PAYMENTS.

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
(*h*) *Poultry (contd.)*	Rs.	Rs.	
Diseases of Poultry, Orisaa	640 0 0	...	(*a*) Inconsiderable
—do— Hyderabad	...	...	
—do— Mysore	2,160 0 0	..	
—do— Bombay (Baroda)	447 0 0	+ 3 0 0(*a*)	
Poultry Research, Madhya Pardesh	...	+460 0 0(*b*)	(*b*) Demand for funds not received.
Helminth parasites affecting poultry, I. V. R. I.	...	...	
(*i*) *Fish*			
Rural Pisciculture, Madras	18,400 0 0	+10 0 0(*a*)	
Fishery Research Scholarship, Travancore	5,400 0 0	...	
Scheme for fish eggs and larvæ, Bombay	16 0 0	—16 0 0(*a*)	
(*j*) *Apiculture*			
Bee-Keeping, Punjab	4,860 0 0	...	
(*k*) *Miscellaneous*			
Using cows for work, I.D.R.I.	3,956 6 0	+73 10 0(*a*)	
Using cows for work, Mysore	...	...	
Using cows for work, other centres	...	...	
(iii) Combined Agriculture & Animal Husbandry Schemes			
(*a*) *Development*			
Village Projects, Bombay (Baroda)	291 2 6	— 1 2 6(*a*)	(*a*) Inconsiderable
Milk yielding trees, Bombay	...	...	
Village Projects, Uttar Pardesh	96 4 0	+ 3 12 0(*a*)	

RECEIPTS

Head of Account	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		12,200	...
		4,700	4,400
		...	220
		5,080	940
		1,50,000	33,730
		...	500
		500	...
		970	1,020
		2,000	1,120
		...	1,000
		...	1,380
		1,270	1,270
		750	120
		...	400

PAYMENTS			
Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs	Rs.	
(*b*) *Fodder and Grazing*			
Silage making, P.E.P.S.U.	...	...	
Kudzu Vine, I. A. R. I.	4,400 0 0	...	
(*c*) *Statistics*			
Statistical Section	221 0 0	— 1 0 0(*a*)	
F. A. O. Training Centre in Statistics	454 2 0	—485 14 0(*a*)	
(*iv*) Miscellaneous Schemes			
Crop-cutting experiments	33,727 0 0	+ 3 0 0(*a*)	
D—CONTRIBUTION TO OTHER SCIENTIFIC INSTITUTIONS.			
(*i*) *Indian*			
Current Science Association	500 0 0	...	
The Horticulture Society of India	...	...	
The Indian Dairy Science Association	781 6 0	+238 10 0(*a*)	(*a*) Inconsiderable
The Entomology Society of India	1,348 7 0	—128 7 0(*a*)	
Indian Society of Agriculture Economics	1,000 0 0	...	
Indian Society of Agricultural & Animal Husbandry Statistics	1,373 14 0	+ 6 2 0(*a*)	
Indian Phytopathological Society	1,268 8 0	+ 1 8 0(*a*)	
Monograph on the funge of India, ICAR	124 8 0	+ 4 8 0(*a*)	
Indian Poultry Club	393 0 0	+ 7 0 0(*a*)	

RECEIPTS

Head of Account	Receipt during the year	Grants	
		Original	Net
1	2	3	4
		Rs.	Rs.
		52,600	73,100
		100	...
		1,500	3,530
		7,500	14,650
		15,000	3,080

PAYMENTS

Head of Account.	Expenditure during the year.	Excess (—) or saving (+) over net grant.	Remarks.
5	6	7	8
	Rs	Rs.	
(*ii*) *Commonwealth and Imperial*			
Commonwealth Agricultural Bureaux Imperial Institute of Mycology Imperial Institute of Entomology Farnham House Laboratory Imperial Bureaux of Dairy Science Fruit Preservation Research Station, Campden	73,013 5 4	+86 10 8(*a*)	
International Dairy Federation	...	—	
E.—DEBTS & REMITTANCES			
1. Loans and Advances	3,528 10 8	+ 1 5 4(*a*)	(*a*) Inconsiderable
2. Deposits and Advances repayable	14,085 7 0	+564 9 0(*a*)	
3. Payments of Income-tax, Provident Funds, etc.	3,079 1 0	+ 0 15 0(*a*)	
Total :	17,78,756 11 10		
Amount transferred to Areanut Committee	60,000 0 0		
Investment and re-investment in fixed deposits	40,00,000 0 0		
Closing balance	3,85,297 2 5*		
GRAND TOTAL :	62,24,053 14 3		

* This does not include a sum of Rs. 1,468/1/6 standing in the Reserve Fund Account.

II. *Details of Advances*	Rs.
1. Permanent Advance with the Secretary, I.C.A.R	250 0 0
2. Permanent advances with the rural development Officer	200 0 0
	450 0 0

III. *Particulars of Securities etc.*		*Face Value*			*Purchase Value*		
		Rs.	A.	P.	Rs.	A.	P.
1. 3% 2nd Victory loan 1959–61		5,00,000	0	0	5,03,125	0	0
2. 3% Victory loan 1957	(i)	16,62,800	0	0	17,27,753	2	0
	(ii)	1,93,400	0	0	1,99,983	14	1
3. 3% Stock 1963-65		16,49,500	0	0	15,54 334	0	0
4. $2\frac{3}{4}$% Stock 1962	(i)	4,00,000	0	0	4,02,736	9	0
	(ii)	5,50,000	0	0	5,50,000	0	0
5. 3 Fixed Deposit Receipts for 50,000/- each repayable at a week's notice Nos. C87,986 to C 87,988		1,50,000	0	0			
6. 10 Deposit Receipts for Rs 50,000/- each repayable at a week,s notice Nos. D09914 to D09923		5,00,000	0	0			
7. 12 Deposit Receipts for Rs. 50,000 each repayable at a week's notice Nos. D30897 to D30908		6,00,000	0	0			
8. 14 Deposit Receipts for Rs. 50,000/- each repayable at a week's notice Nos. D31190 to D31200 and D38201 to D38203		7,00,000	0	0			

9.	10 Deposit Receipts for Rs. 50,000/- each repayable at a week's notice D38251 to D38260	5,00,000	0	0
10.	10 Deposit Receipts for Rs. 50,000/- each repayable at a week's notice Nos. C03020 to C03029	5,00,000	0	0
11.	10 Deposits Receipts for Rs. 50,000/- each repayable at a week's notice Nos. D38591 to D38600	5,00,000	0	0
12.	18 Fixed Deposits Receipts for Rs. 50,000/- each repayable after 12 months Nos. D70326 to D70343	9,00,000	0	0
13.	13 Deposits Receipts for Rs. 50,000/- each repayable at a week's notice Nos. D70074 to D70086	6,50,000	0	0
14.	1 Fixed Deposit Receipt repayable after 12 months No. D70325	4,00,000	0	0
15.	30 Deposit Receipts repayable at a week's notice D70752 to D70781	15,00,000	0	0
16	10 National Savings Certificates Nos. NS/F 087031 to 087035 and 087037 to 087041	50,000	0	0
	Total Securities	1,19,05,700	0	0

IV. Particulars of closing Balances.

(1)	Cash in hand with the Secretary, I. C. A. R.	133	7	0
(2)	In current account with the Imperial Bank of India, New Delhi and Post Office	3,86,631	12	11*
		3,86,765	3	11

*Imperial Bank of India New Delhi

(i) General A/c	3,53,051	4	5
(ii) Reserve Fund A/c	1,468	1	6
Post Office	32,112	7	0
	3,86,631	12	11

N. K. Bhajwani,
Secretary,
Indian Council of Agricultural Research

The accounts have been examined and according to best of my information and in consideration of the explanation given as a result of test audit of the accounts, they are correct.

T. C. Puri
Examiner,
Outside Audit Department (c)
Central Revenues

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